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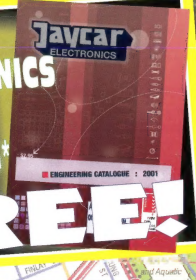

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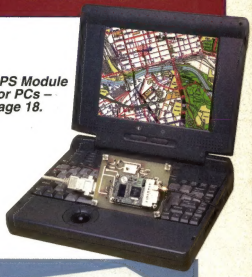

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Publisher & Editor-in-Chief
Leo Simpson, B.Bus., FAICD

Production Manager
Greg Swain, B.Sc.(Hons.)

Technical Staff
John Clarke, B.E.(Elec.)
Peter Smith
Ross Tester
Rick Walters

Reader Services
Ann Jenkinson

Advertising Enquiries
Rick Winkler
Phone (02) 9979 5644
Fax (02) 9979 6503
Mobile: 0408 34 6669

Regular Contributors
Brendan Akhurst
Louis Challis
Rodney Champness
Julian Edgar, Dip.T.(Sec.), B.Ed
Jim Rowe, B.A., B.Sc, VK2ZLO
Mike Sheriff, B.Sc, VK2YFK
Philip Watson, MIREE, VK2ZPW
Bob Young

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PUBLISHER'S LETTER

Time for a change in the electrical wiring rules

As foreshadowed last month, we have produced a petition to politicians throughout Australia, to change the electrical wiring rules in each state, to the system which has been used in New Zealand since 1992. This allows homeowners to do their own electrical wiring.

I appeal to all readers to check out pages 48 & 49 of this issue. Strictly speaking, you will find that it is a "letter of will" rather than a petition because petitions have a long record of being ignored by politicians and parliaments. Please fill in the form and send it to us so we can send it on to the relevant politicians in each state. We need your support.

Since it was raised back in June 2000, this issue has generated far more heat, and more correspondence, than any other. More particularly, we have been accused of producing a hate campaign against electricians and being one-sided in our publication of the various letters.

Well, readers can draw their own conclusions on both aspects but it is well to remember why the whole debate was triggered off in the first place: because it is now illegal for anyone in Queensland to assemble or repair a mains-powered project or appliance unless they are a licensed electrician. This ludicrous situation applies to the repair of all electronic equipment, whether it is a VCR, TV or exotic medical equipment such as CT scanners - regardless of the fact that most (not all, I hasten to say) electricians have very little knowledge of electronics.

Then a reader brought our attention to the fact that, in New Zealand and other countries, homeowners can not only do repairs on electrical equipment, they can also do their own home wiring. This situation in New Zealand has been in place since 1992. And apparently, there has been no increase in electrical fatalities since its inception.

Since we made this point, some readers have claimed that the New Zealand statistics are dodgy. Well, they're not. We do not think there will be an increase in deaths brought about by dodgy wiring, when homeowners are eventually allowed to do their own wiring. Rather, we expect overall safety to improve because the various electrical authorities will be forced to carry out education campaigns on how wiring should be done. We look forward to that.

Since this situation has blown up, NCP (National Competition Policy) reviews of electrical safety related legislation have started in most states. These reviews will impinge directly on this issue of home-wiring. Interested readers are invited to make submissions but you will need to move quickly. In Queensland, if you want to make a submission, you need to contact the Queensland State Treasury by the end of this month (31st March 2001).

The same advice applies to Tasmania, Western Australia and New South Wales. The legislation in each state should be changed. Let's get it done.

Leo Simpson

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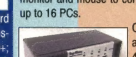

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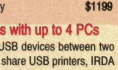

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MAILBAG

Electrical licensing debate

I have been following the debate on electrical licensing with interest. Some years ago, when the late Neville Williams had a column called "The Way I See It", I wrote in detailing my attempts to obtain an electrician's license from the background of a professional electrical engineer.

I went to the local TAFE (as it was in those days) to the electrical trades department for the requirements. Basically they amounted to: (1) university degree in electrical engineering – yes; (2) sitting the regulations exam (I had no objection to that); (3) a minimum of 12 month's "hands on" experience – yes; but if I did that I would only get a class B license.

I didn't pursue the matter any further.

This leads to a hypocritical situation whereby, as a professional engineer, I can design and specify installations but not actually pick up any tools to do the work.

Is this any less hypocritical than being able to go to the local supermarket to buy electrical fittings, which encourages anyone to go ahead and wire them up? I see some fittings have the statement along the lines of "must be installed by a licensed electrician or other suitably qualified personnel". I wonder about the "other suitably qualified personnel".

Yes, amateurs have certainly been known to produce some dangerous situations. But I'm sure I'm not alone in having had to fix dangerous situations created by licensed electricians. Here are two examples.

(1) In a new building that was inspected, people on the first floor started getting tingles after about six months. The wiring to the first floor came up to two boxes of circuit breakers. The only connection between the earth links in each box was the metal to metal contact between the two boxes! After six months, this contact disappeared.

(2) At a friend's house, the original wiring layout in the fuse box was a star pattern from the switched side of the main switch to the fuseholders for the separate circuits. When an extra circuit for a shed was added, there was no room in the terminal of the switched side of the main switch, so the new wire was added to the unswitched side of the main switch!

It will be interesting to see how things evolve.

Name withheld at writer's request.

Please stop electrician bashing

I have been following with interest your current forum on the issue of Electrical Licensing and have hesitated to put forward my views to this point for two reasons. One being that I try to avoid issues unless I can see them becoming unreasonable. Second, because I belong to that despised group of individuals, licensed electricians, and as such, am averse to being pilloried for airing my views.

May I begin by saying that I have spent over 37 years in the trade and over that time I have seen very well installed home brews and also some frightening situations. I am not averse to giving a person, whom I feel I can trust, the gear and advice to allow them to install the odd power-point or light; with the proviso I check it out after its done to make sure all is OK.

I feel the debate has been quite unreasonable all along. In my perception, it smacks of sour grapes on the part of technically capable people who have their noses out of joint because by law, they have to leave what they perceive as technically simple work to those whom they perceive to be technically inferior.

This includes you Mr Simpson, as testified by the amazingly stupid statements made in your editorial of the March 2001 edition. You have obviously missed the point completely, when you imply that electricians are going to act as policemen, looking for opportunities to report anything they see as out of the norm (including "neat" wiring).

At this point I have to take exception to the implication you make by the statement "Because it's neat and obviously not done by any normal electrician?" I find it difficult to describe my rage at the arrogance of that statement. You use the privilege of your editorship to blatantly insult a large proportion of your readers! I am one and I know many other electricians who take great pride in a neat job well executed.

These statements, together with others along the lines that the whole thing is a plot to perpetuate the livelihood of electricians, shows to me, and I'm sure most other electricians, that you cannot see the realities of what happens out in the field simply because you do not work there.

I recognise, as do all competent electricians, that there are, what one correspondent referred to as, "bad apples". But in this case, the whole barrel is not spoilt. On the contrary, the vast majority of electricians are very conscientious about the safety of their work. Certainly, it isn't always pretty but it's safe. You speak of wiring that couldn't be done by an electrician because its neat. I've come across wiring run very neatly, nice and straight, nailed with a clout through the middle of the twin cable!

I'm sure all experienced electricians will have some horror tale to tell of something they have come across in the way of home wiring. One of a number I can give is of the father with five young children who proudly told me he had installed all the power points himself. He had installed power points in every room, all in figure-8 cable without an earth wire in sight and certainly no thought of polarity (what's that?). I could go on but the point I'm trying to make here is that some people should be reported to the authorities for endangering the lives of others.

Electricians, despite what you and your supporters may think, are in the main, responsible people with a high regard for safety and life. Indeed, it is a part of our training to be responsible in these areas. If I see a job that has been well executed and is within the rules, though I can tell (and, believe me, a trained eye can) that it has not been done by a licensed electrician, why should I report the matter? Do you really think we are going to be that vindictive?

On the other hand, anyone who does a horror job like the one described above is culpable and should be reported for their own good and, more importantly, for the good of those they may kill.

Licensing authorities have to draw the line somewhere and, at present, the line precludes wiring by unlicensed people. If some technically capable people have their noses out of joint, perhaps they should recognise that the law is in place not just to stop them from doing their own wiring, but to save incompetent people and other innocents from death by stupidity.

The letter from the Queensland ELB stated that they intend to review their legislation and will take into account the issues raised by your correspondents. Hopefully, some accommodation for these concerns can be found without compromising safety.

My only requests are these: (1) Stop the electrician bashing. It smacks of elitism on the part of those who perceive themselves to be technically superior. (2) Don't advocate the scrapping of regulations. They are in place to protect the public from danger (often from themselves).

If you have your way and the death toll by electrocution rises, you are going to have to live with that. Is that what you want?

Ian McGrath,
via email.

Comment: it was (and still is) the intention of the Queensland ELB that electricians would be policemen. We did not imply it. Based on the experience in New Zealand and other countries, we do not think there will be a rise in deaths due to electrocution if homeowners are eventually allowed to do their own wiring.

Another wiring horror story

I have followed the editorial and correspondence on the electrical wiring debate as an interested reader since it started. I became more than an interested reader last month, when I saw first-hand evidence of an example of some house-wiring.

Friends of mine were aware I have had a Residual Current Device (RCD) installed at my house and witnessed its value in preventing a possible fire when my wife's steam iron failed recently. After discussing the merits of the device with me, they made arrangements to have one installed in their much older house for peace of mind, in view of all the electronic equipment permanently connected to the supply and their aging appliances.

It wasn't long after the installation was completed that I received a call and was told that switching on a wall bracket lamp caused the safety switch to trip. I suggested that it may be faulty although I expected it should be connected to a lighting circuit and not a power circuit. In fact, removing a lighting fuse did cut the power to the light.

That weekend I received another call from my friend asking why there was a red and a white wire in one terminal of a switch. I was unable to answer that on the phone and advised him to cease fiddling as he had no electrical knowledge and was in a dangerous area, which is how I became involved. I knew he would continue despite his lack of knowledge, so I went to visit him – for his own safety.

The architrave light switch group was out of its place and a tangle of wires was on show. What I found amazed me! By investigation I found that the wall-bracket had been wired through the wall to a switch using figure-8 flex. Where it reached the switch it was split apart and one conductor disappeared down inside the

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Mailbag – continued . . .

architrave; the other went to the switch. After much investigation I found that this light used the power-outlet neutral to complete the circuit, thus causing the imbalance and tripping the RCD.

I removed the wall bracket and faulty wiring, then refitted the switches. I had traced another wire when I found its sheath changed colour from black to white somewhere in the wall and indeed, a white wire was the 'unswitched active'; the red wire was missing. Over a cup of tea, I commented that the wiring was quite a mess and recapped what I had found. My friend's wife told me that all electrical contractors who have done work at that house have said the same thing.

Her next comment amazed me. She said, "Did I tell you the previous owner was an electrician?" It begs the question: what standard did he use to wire his own house?

Barry Ring,
Croydon Hills, Vic.

February issue was enjoyable

Thanks for another bumper issue of SILICON CHIP. I really enjoyed the meteor counter article. More of this stuff please.

Your article on the train controller is what I would call a perfect balance of theory, diagrams and construction info. I will probably never build one, but I indulged in reading the article as a "mini lecture" in op amp and motor control theory. The scope screen captures really make it so much more interesting.

If I lose my job and have to cut back expenses, I will just have to go without food for a day or so, and keep SILICON CHIP!

Garry Boyce,
Crafers, SA.

Volunteer Coast Guard need equipment

I am hoping to get some assistance for the Australian Volunteer Coast Guard (a NSW State Emergency Service) in setting up in-house servicing for the electronic equipment used in their operation. The facility is situated on the coast at Kingscliff, NSW and monitors seagoing traffic. It is a completely volunteer operated organisation.

The main equipment in use is 27MHz HF SSB transceivers, some VHF links and standby power supplies. At present, this equipment is serviced in Brisbane at an on-going high cost and resultant down-time.

The basic test equipment needed to set up this service would be a general purpose oscilloscope, RF and audio signal generators and a suitable multimeter, Other test equipment such as dummy loads, etc could be easily fabricated here.

We were hoping that someone or some organisation would be able to assist in providing equipment for this worthwhile cause.

If any further information is required, please contact the commander, Ted Griffiths, Kingscliff Flotilla, Australian Volunteer Coast Guard. Phone (02) 6674 3532.

Laurie Larsen,
Kingscliff, NSW.

Blue Mountains Amateur Radio Club

Your editorial in the February issue regarding electronics clubs prompted me to let you know about the Blue Mountains Amateur Radio Club (BMARC). Recently we relocated the Club to St Columba's School in North Springwood, for a number of reasons.

Primarily, the club had outgrown its old accommodation and was set to expand with the addition of 6m and 10m repeaters to our existing 2m and 70cm repeaters. What brought us to St Columba's was the series of electronics classes the school includes in its curriculum. This brought the chance to interact with the school on electronics-based projects, with the additional aim of fostering interest in amateur radio among the students.

We have now established the club in the school's electronics classrooms. We are commencing work on the club station and the installation of a 20m tower. The station will be also be open to use by the students (under the supervision of their teacher, a licensed amateur). It will house additional equipment for the students, including weather fax and weather satellite receivers.

The club has also been able to assist the school in the purchase of equipment, as well as sponsoring prizes at the end of the school year for electronics students. Future projects include the construction and installation of the school's 14m-diameter radio telescope and ancillary equipment. We have also been able to involve students in classes other than electronics – the woodwork students will be building furniture for our new club station.

Anyone wishing to know more about our club and our projects is most welcome to contact us.

Phil Derbyshire, VK2FIL
PO Box 54,
Springwood NSW 2777.
www.qsl.net/bmarc/

Nepean Amateur Radio Group

I am writing to you regarding the March editorial on electronic clubs. Our club is the Nepean Amateur Radio Group located at Kingswood in western Sydney. We meet every second Tuesday of the month and all are welcome.

http://www.qsl.net/narg
email: narg@qsl.net.au
Gavin Kelly,
via email.

Vintage radio article a benchmark

Congratulations are due to Rodney Champness and SILICON CHIP for a magnificent Vintage Radio article in the March 2001 issue. SILICON CHIP is a consistently good read but you have produced the best vintage radio ever in this one.

It has it all: excellent choice of an interesting subject in the 1929 AWA set, unusual design features in the unneutralized (losser) TRF front-end and push-pull driver stage for the audio, brilliant photographs of the cabinet and chassis/components, a circuit diagram that is crystal-clear and Rodney's engaging account of how he brought the set back to its former Depression-era glory.

In all: this is an edition for the collector! It will be highly prized as a reference document. Thank you and please give us more of this.

Chris Morgan,
via email.

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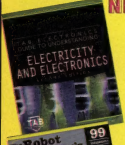

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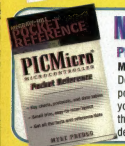

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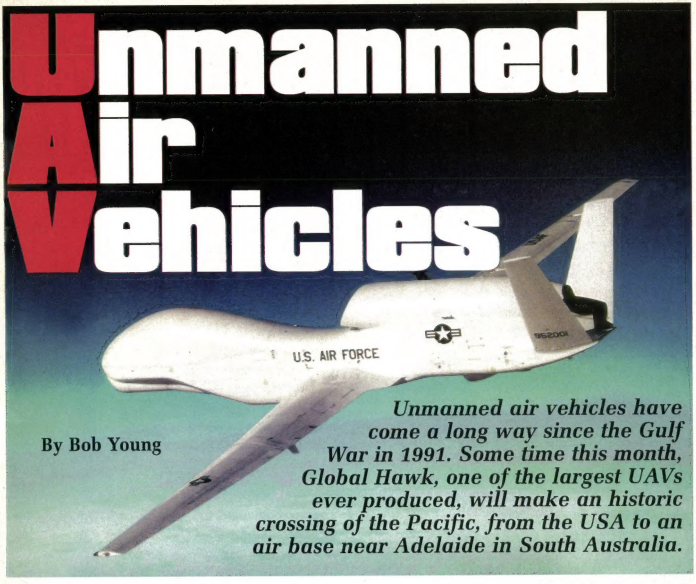
Unmanned Air Vehicles



By Bob Young

Unmanned air vehicles have come a long way since the Gulf War in 1991. Some time this month, Global Hawk, one of the largest UAVs ever produced, will make an historic crossing of the Pacific, from the USA to an air base near Adelaide in South Australia.

– a force to be reckoned with

You can forget any idea that UAVs are just tiny radio-controlled model aircraft with perhaps a video link for remote monitoring.

Global Hawk (pictured above) is big, a full-sized aircraft; it weighs more than 11 tonnes and has a payload of over 900kg. And it has a wing-span of 35.42 metres and is 13.53 metres long.

Not only that, Global Hawk has a range of more than 25,000km, an endurance of 36 hours and a maximum altitude of more than 65,000 feet.

By comparison, a Cessna Citation business jet weighs about 16 tonnes, has a payload of about 620kg, a wing-span of 19.4 metres and is 22 metres long. Its range is about 5,500km and ceiling (maximum altitude) is 50,000 feet.

Yes, Big Brother in the form of a UAV could be watching you right now!

Global Hawk is one of many in a long line of UAVs which really came into their own during the Gulf War in 1991. SILICON CHIP had a series of four articles on UAVs during 1993 and a review of the models described then shows just how far we have come in the intervening eight years. UAVs are now very complex devices.

Here is a machine that requires the most advanced computer technology, electronic control and surveillance equipment, aeronautical engineering,

and finally a unique approach to mission planning by the UAV control team. They might be unmanned but they require a skilled team to control them.

And the Holy Grail of UAV dreamers?

Nothing less than the UCAV, the Unmanned Combat Air Vehicle, the pilotless air superiority and/or ground attack fighter. To date it remains a fabulous dream and it will be for some time to come. Or at least it will until the arrival of artificial intelligence (AI) and control links free of jamming or interference.

The simple fact is that a human pilot is an extremely difficult item to replace. But that does not mean that the UAV has no place in military and civilian endeavours. Far from it! The proliferation of UAVs has reached staggering proportions, ranging in size from micro vehicles, with a wingspan of just 150mm, to the huge Global Hawk mentioned above. Without doubt, UAV technology will progress very quickly from here on.

Australia, after showing the world how it should be done with the Jindivik, one of the most successful UAV programs the world has yet seen, has let matters slide and is now almost totally reliant on imported UAVs to fill the needs of the Australian Defence Forces.

Australian UAVs

However, in the commercial field there is quite a deal Australian activity. Probably one of the best known and most successful is the Aerosonde, a robotic aircraft capable of fully autonomous operation over vast distances. SILICON CHIP featured an article on the first successful crossing of the Atlantic by the Aerosonde in the May 1999 issue. That flight took approximately 27 hours and covered some 3270km. During the flight the engine consumed just six litres of fuel for an average fuel consumption of 1600 miles to the gallon!

The original Aerosonde, an Australian-made UAV which undertook the first successful crossing of the Atlantic, covering some 3270km in 27 hours on just six litres of fuel!

It was a stunning achievement and proved beyond a shadow of a doubt that the small UAV was now capable of major undertakings.

Designed and built in Melbourne, initially as a meteorological research aircraft, the Aerosonde is now being used in an ever widening range of tasks. Subject to a constant program of upgrading, the Mark 3 Aerosonde is a much improved machine, featuring a new airframe, a more powerful fuel-injected engine and Low Earth Orbit satellite communications.

The author was fortunate enough to attend a UAV conference held in Melbourne in February, during which Dr. Greg Holland, the CEO of Aerosonde Ltd, stunned those in attendance with a presentation of the operational capabilities of the Mark 3. The simplicity of operation and the capability of this little aircraft left the audience "gobsmacked" (to use a phrase often overheard after the presentation). Coming straight after several presentations of extremely complex military UAVs, Dr Holland provided us with a refreshing view of a system that was ideally suited to small commercial operations.

The Aerosonde has a wingspan of 2.9m and weighs in at 13-14kg. Fitted with a 24cc fuel-injected engine running on unleaded petrol, it has a speed range of 18-32 metres per second and

A deceptively simple-looking UAV, the Avatar electric powered glider is manufactured in Canberra by Codarra Advanced Systems. It is designed as a man-portable tactical system, with an "over the hill or look around the corner" capability within a localised area of interest (up to 5km).

The Prowler II from Aeronautical Systems, claimed to be the next generation in tactical UAVs. It can operate over a 200km range from its base and is designed to give the latest information to front line elements without risk to aircrew.

a climb rate of 2.5 metres per second. Range is 3000km and endurance 30 hours. Operational altitude range is 100-6000 metres. Payload is 2kg with a full fuel load.

Standard instrumentation on all Aerosondes consists of a set of Vaisala RSS901 meteorological instruments for pressure, temperature and humidity, and a proprietary system for determining winds. These instruments provide information that is critical to the aircraft operation and valuable observations that are fed into the global meteorological observation system.

Additional instrumentation packages in use or in development include still and video cameras, atmospheric chemistry and air pollution monitors, range finders, altimeters and remote sensing instruments for monitoring conditions on the Earth's surface. As an example, the camera system is being used to monitor and survey items as diverse as crops to Arctic ice formations. All in all, it is a very simple and useful UAV.

Codarra's Avatar

Another deceptively simple looking UAV, manufactured in Canberra, Australia, by Codarra Advanced Systems, is the Avatar CX-1 electric powered glider. Designed as a man-portable tactical system, the Avatar is intended to provide the commander of a small ground force (a platoon or company) with an "over the hill or look around corners" capability within a localised area of interest (up to 5km).

This type of UAV is particularly useful for scouting ahead of convoys. There is no "area of interest" more demanding of prior knowledge than that bit of road up ahead and just around the corner. Controlled from the lead vehicle, it can look at the road ahead, providing up-to-the minute tactical information. In this regard, it is vitally important that the camera system can discern objects as small as a single man in the open or the number of people in a group.

Avatar is fitted with two video cameras, one under each wing and these are switchable in flight to provide look-ahead or lateral views. They are daylight CCD cameras of varying focal lengths to provide switchable wide angle and zoom capability. The use of a thermal imager has also been investigated.

If you think the Avatar looks just like an ordinary electric-powered model glider then consider the following illustration, involving a small group of personnel. They could be military but could just as easily be emergency services, law enforcement etc).

The AVATAR UAV is first removed from its carrying container and put together. This is a simple exercise which basically requires that the wings and fuselage are clipped together and the batteries inserted. The flight path for reconnaissance is programmed into the on-board autopilot via a notebook computer, merely by selecting way-points on a digital map using a pointer. Altitude is also controlled by a barometric altimeter through the autopilot.

Separate search patterns at each way-point can also be programmed. The selection of the operator's position as the final way-point will ensure that the AVATAR returns on completion of the flight. It is also possible to program events to occur at each way-point, such as camera on, camera off, etc. This assembly and programming procedure is expected to take no more than 10 minutes.

Once programming is complete, the AVATAR is hand-launched. The flight

The ship is full size, the aircraft is not: it's the Fire Scout "Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle" (why don't they say helicopter?) made by Northrop Grumman. It's designed to supply navies with intelligence and targeting capability "in littoral battle space" (ie, close up and personal without the person!).

Aeronautical Systems' "Altair", an unmanned aircraft developed in partnership with NASA for scientific and commercial users. It features large payload capacity, 52,000ft ceiling and can stay airborne for up to 32 hours.

Look! Up in the sky: is it a bird? Is it a plane? Is it a washing machine? No, it's a tiny Micro Craft duct-fan micro UAV which, unlike fixed wing craft, has the ability to "perch and stare" with little chance of being seen or heard, even when directly overhead a target.

program then takes over and automatically moves the UAV onto the flight path at the set altitude. Further investigation of objects observed during flight can be achieved by taking manual control of the UAV and flying it via a set of virtual reality goggles. On completion of any such manual over-ride, AVATAR can be returned to autopilot and it will resume the programmed flight path. Way-points may also be changed during flight.

Images from AVATAR are currently received on the same notebook computer while the UAV is within line of sight. (Codarra are also investigating methods of storing imagery onboard when beyond line of sight, and then down-loading later). Images captured on the notebook computer are transferred to other command systems or headquarters via a mobile telephone or other communications link, including being published on the Internet. The actual track flown by the aircraft is painted onto the moving map display.

AVATAR is a reusable platform. The UAV is recovered at the end of the sortie with a parachute and prepared for flight with additional batteries and new flight programming.

The all-up weight of the aircraft is approximately 3.5kg and wing span is 2.5 metres. Endurance is approximately 20 minutes on a standard set of NiCd batteries and cruise speed is 40 knots.

Flight trials have indicated that the AVATAR is a very stealthy vehicle, almost impossible to hear when operating at about 100 metres. The use of electric propulsion reduces the infrared signature to undetectable levels. Even when the earlier CX-1 vehicle was painted in bright colours, visual detection was very difficult when only a few hundred metres away.

Launch, recovery and control are very important considerations for tactical UAVs which more often than not operate out of rugged, uncleared terrain. The Avatar is hand-launched and the onboard autopilot reduces flight training to minimum levels. Landing is usually by parachute while conventional landings require only a small clearing for an experienced operator.

Keep in mind here that the CX-1 is a very small aeroplane with a small diameter fuselage. One wonders how the designers have managed to fit this level of sophistication into such a small airframe.

Do-it-yourself UAVs

Technology is moving fast and has now made the small commercial UAV a definite proposition.

In fact, relatively ordinary model aircraft can now be effectively converted to UAV operation with a variety of autonomous flight control modules, some of which are pictured in this article.

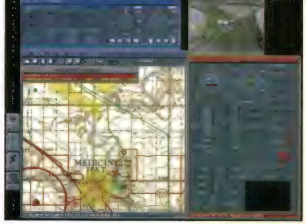
All of these modules are designed to interface into a standard model aircraft radio control system: the PDC10 GPS steering unit, the PDC20 altitude hold and the PDC25 auto-throttle (airspeed) control. Each modular control unit is designed to plug into a standard R/C airborne system between the receiver and the servos. A GPS receiver or GPS module is also required.

PDC10 GPS steering module

The microprocessor-based PDC10 receives data from a handheld GPS receiver and converts it to an R/C servo position command. Your GPS receiver performs the navigation calculations and manages way-points and routes. Simply connect the handheld's PC data cable to the PDC10 and it will translate the track/bearing error into a servo position command. The PDC10 also corrects for cross-track error so it will stay on course for long distance navigation. It has an enable input for transparent pass-through control, a Gain adjustment and an exclusive PDC TRIM-MATCH feature which eliminates the need for a servo centre pot.

So the PDC10 and a handheld GPS receiver are all that are needed to steer a boat, ground vehicle or stable aircraft to a way-point. Add a wing-leveller and a PDC20 altitude hold and you have a complete aircraft control system at a fraction of the cost of a traditional autopilot. The PDC10 is designed to be a functional component of an unmanned guidance system and its low cost makes it ideal for expendable UAVs.

To get the modules to automatically take control when the R/C radio loses command signal, you need to use an R/C system such as PCM that comes with a built-in fail-safe (preset) feature. The PDC modules can also be used with standard AM or FM (PPM) R/C radios but to get the units to enable automatically, you will need to add a "missing pulse detector" (P.O.D.) fail-safe accessory. The type of encoding (PCM, PPM) is not relevant, only



Just some idea of the information available back on the ground can be gleaned from this screen grab of one of the UAV control programs from CDL Systems. A high-res location map (linked to GPS), video image from the plane with the target highlighted and complete flight/status information about the aircraft itself is displayed on screen in real time.

the fact that the radio has a built-in fail-safe feature.

Altitude & Air speed hold

The PDC20 (Altitude hold) and PDC25 (Airspeed hold) operate as set and hold units. To program these units, the model is flown manually at the speed and altitude required and then each unit is enabled. The current speed and altitude are then stored in memory and remain as the default (fail-safe) settings. To re-program either speed or altitude, the appropriate unit is disabled and the aircraft is flown at the new speed and/or altitude and the module enabled again. Upon loss of signal, either accidental or deliberate, the modules will default to the last setting.

These two units can be a boon to pupils and instructors during initial flight training. Pupils have a great deal of difficulty holding the throttle lever in the mid-range setting and there is a tendency for the throttle to gradually be pushed to the full open setting, thus increasing the speed of the model to an uncomfortable level. The PDC25 takes care of this automatically.

Likewise, when teaching the pupil to steer the aircraft, elevator control can be handed over to the PDC20 which will then hold the aircraft at a safe altitude. This takes considerable strain off both the student and the instructor.

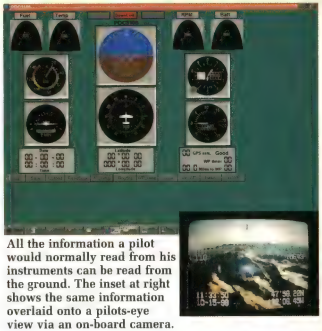
Using the PDC10 in conjunction with a GPS receiver, a wing levelling unit (optical or gyroscopic), a PDC20 and a PDC25 (optional), an aircraft can be sent off on a fully automatically controlled mission to any point within range of the aircraft. Manual control via the transmitter is only required for take-off and landing. The transmitter may be switched off for the rest of the flight. Such a system costs in the order of $1500 - $2000.

The PDC3200 is the command module for a more elaborate (and expensive, about $10,000) full autopilot system. Inputs are provided for two rate-based gyros, altimeter and airspeed sensors, fuel, RPM, battery voltage. Aircraft attitude and all data inputs are relayed to a computer ground station which displays the information on a cockpit like screen. GPS way-points and airdata (speed, altitude) settings may be updated in flight if required.

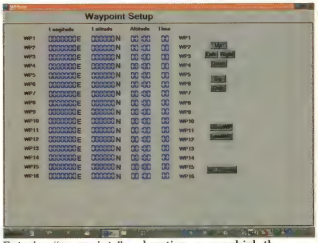
This type of system is ideal for extended range missions, such as aerial photography, fire detection, traffic surveillance etc. If a video link is mounted in the aircraft, the PDC1200 (or PDC1200PAL for Australia) is a most effective method of transmitting data back to the ground station.

The PDC1200 is a video overlay unit. In other words it can overlay text onto the video display as shown in one of the photos in this article. Here we see Compass Bearing, Airspeed, Altitude, Time, Date and Position overlaid.

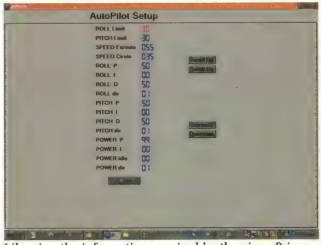
As you can see, automatic flight systems make possible projects that were only dreamed about several years ago. **SC**



All the information a pilot would normally read from his instruments can be read from the ground. The inset at right shows the same information overlaid onto a pilots-eye view via an on-board camera.



Entering "waypoints" or locations over which the aircraft must travel is as simple as entering their latitude, longitude, altitude and time. These are then referenced against an on-board GPS receiver.



Likewise, the information required by the aircraft in "autopilot" mode is simply entered – the plane will then obey these commands until instructed otherwise.

Curses - The Jaycar Catalogue Is Gone!!

The April issue of this magazine included a copy of the totally new 308 page 2001 Jaycar FULL COLOUR CATALOGUE. It is crammed with hundreds of new and exciting products! If you only have the magazine, it means that some scoundrel has run off with the catalogue. NOT TO WORRY! Simply fill in the coupon below, mail it to us and include $5 (cheque, money order) or phone/fax us with credit card details and we will post one to you. **We will also include a credit note for $6**, with the catalogue for you to use towards your first purchase from the new catalogue.

CD-ROM: The 2001 Catalogue on CD-ROM will be available June 2001. Price is $2.50. If you are near a Jaycar shop or participating dealer, you can call in and get a catalogue for free. You will need to have a copy of the April Silicon Chip magazine with you. This offer for personal shoppers expires end May 2001. If you do not have a copy of April 2001 Silicon Chip, the catalogue will cost $2.95 (or $5 posted).

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NEW KITS FROM JAYCAR

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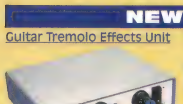

Ref Silicon Chip magazine April '01
Add another popular music effect to your repertoire. Tremolo effect is generated by rapidly varying the volume over time. This unit fits into a case, 140 x 110 x 35mm, includes two adjustments for modulation rate and depth. An LED will flash at the same rate as the volume modulation.
Kit includes Case, silk-screened panel, PCB, 6.35mm sockets and all electronic components. 12VDC power required – use plugpack MP3006

Cat. KC-5309 $44.95

Dr Video - Video Stabiliser Kit

Refer Silicon Chip magazine April 2001 (exclusive to Jaycar Electronics)
Hidden pulses in video signals can cause the picture to 'jitter' or 'jump' around on the TV or video projector. This low-cost kit removes these nasties and cleans up the video signal for a more stable viewing. A toggle switch allows sharpening or softening of the picture. Please note that this project is designed to achieve stable and steady pictures for viewing and not for recording. Even though this unit cancels macrovision protection, we must point out that recording copyright material is illegal.
Kit supplied with Case (141 x 111 x 35mm), punched and silk-screened panels, PCB and all electronic components. 12VDC plug pack required – use MP3006

Cat. KC-5308 $59.95

Improved FM Stereo 'Minimitter' Transmitter Kit

Refer: Silicon Chip magazine April '01
Due to the tremendous success of the 1988 FM 'Minimitter', the Silicon Chip team has refined it for an even better performance. It now transmits stereo audio signals to a FM radio, within a range of 35 metres. You can connect your CD player (or record player) to the Mini-Mitter and then listen to your favourite CD's or records anywhere in the house, via your Walkman personal portable. Also ideal for playing CD's in your car - via your portable CD player and your car stereo/radio. This design is easier to build and setup.Kit includes PCB, case, front panel and all component parts. 2 x 'AA' batteries as 5VDC power source supplied

Cat. KC-5310 $39.95

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Digital TV in Australia: the picture so far!

Digital TV broadcasts began in Australia in January this year in a less than auspicious beginning. Now set top converters from Thomson are available in the stores and are beginning to trickle out to customers. We decided to take a look at how it's going.

By LEO SIMPSON

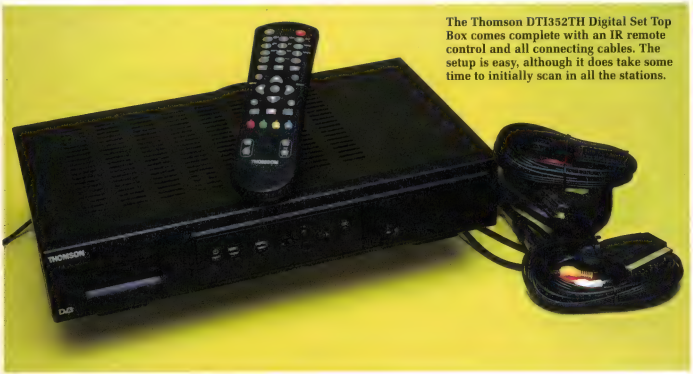
As a first step, we obtained a Thomson DTI352TH Digital Set Top Box which is currently stocked in the Dick Smith Electronics PowerHouse stores. This prosaically named box is similarly unassuming in appearance, considering that it houses state-of-the-art technology. It has a charcoal finish and measures 368mm wide, 70mm high and 225mm deep.

Inside, it has a large double-sided PC board with lots of inscrutable LSI and surface mount chips. On the front panel, there is dark window for the remote control and a few buttons which let you access most of the functions via menus shown on the TV or video monitor's screen.

On the rear panel, there are input and output sockets for the antenna, two RCA sockets for the left and right audio outputs and two SCART sockets to allow connection to a VCR and TV/monitor. The accessories include a SCART to SCART cable and two SCART to three RCA sockets for the VCR and TV connections.

In my situation, connection was easy since I have a Philips stereo TV with a SCART socket and I used one of SCART adaptor cables to connect the VCR. Also on the rear panel is a 2-pin 240VAC mains socket (the box is double-insulated) and an RS-232 socket. The RS232 socket does not get a mention in the instruction manual and so we assume it is used by the manufacturer to set up the parameters for different countries.

The 20-page manual is quite brief



The Thomson DTI352TH Digital Set Top Box comes complete with an IR remote control and all connecting cables. The setup is easy, although it does take some time to initially scan in all the stations.

These two pictures dramatically demonstrate the improvement in the author's SBS reception via the Thomson Set Top Box. The SBS off-air analog signal shown at left is noisy, with no colour, while the digital signal has full colour and is as clean as a whistle. A set top box is very effective when it comes to cleaning up off-air signals in difficult reception areas.

but an Australian produced single-page instruction sheet contains enough info to get you started. Basically you connect all the cables, turn it on and press the remote control buttons to bring up a number of menus and then you click down them as instructed. Once you have gone through the initial setup the on-screen menus are more-or-less self-explanatory.

Setting up

The setup procedure does take quite a long time although you can read a book or have a cup of coffee (or both) while the machine goes through the full VHF & UHF tuning range (from 45MHz to 820MHz) and verifying the existence of digital services. The process seems to take forever but is around 30 minutes or so.

In my case, the Thomson box announced that 19 services had been found and installed: one from the Seven Network, four from the Nine Network, six from the Ten Network, three from ABC TV and five from SBS. Bewdy mate! All these extra channels to watch!

From then on you can decide whether you want to watch the TV broadcasts in wide-screen (16:9), letter-box or 4:3 Pan & Scan. My TV is a not a wide-screen model so that rules out the first option and I am not keen on letter-box mode either so I did most of my watching in 4:3 pan and scan. Can you pan & scan? I couldn't so that feature may not yet be enabled.

The remote control is quite good and it allows you to control the volume as well as channel selection. Other buttons allow you to bring up various on-screen menus which, among other things, allow you to display channel and program lists (if available for that particular channel) and even to lock out individual channels (eg, if you don't want the kids to watch something).

Reception quality

I had a particular interest in reviewing this set top box because my TV reception is quite variable, depending on which set of broadcast transmitters I use. In my exposed position high above one of Sydney's' northern beaches I can receive signals from the main broadcast antennas clustered around Gore Hill or I have a choice of UHF translators at North Head or in Bouddi National Park.

However, I particularly wanted to check the TV reception from the main broadcast towers in Sydney. Those signals are received by a combination VHF/UHF yagi antenna but we do not have line-of-sight reception. Consequently, while the VHF signals are quite strong they are subject to varying degrees of ghosting, particularly on ABC channel 2. Moreover, channel 2 is subject to varying amounts of local interference, some mains-borne due to motors and power tools and some due to unidentified RF sources.

Much worse is the UHF reception from SBS, which is weaker since the beginning of DTV. In fact, with the antenna signal fed direct to my TV,

This view shows the on-screen menu that comes up when you go to another channel. This information typically includes the name of the current program and by pressing the right arrow on the remote, you can also find out what's on next. The yellow button brings up a list for that channel.

A digital set top box is very effective when it comes to eliminating ghosts, as these two shots from Ch10 demonstrate. The picture at left is the analog off-air signal, which shows obvious ghosting and some noise due to RF interference. By contrast, the digital signal at right is ghost and noise-free.

the reception is so noisy that there is no colour. Feeding it via the VCR and then into the TV improves it to the point where colour is present but it is still noisy. So I thought that these signals would be a good test. And they were.

In any case, while digital broadcasts are planned from most, if not all, UHF translators, they have yet to be announced, let alone start. So the main VHF broadcasts plus SBS it had to be.

Exorcising ghosts

In fact, all the Sydney channels including SBS were received completely noise-free and ghost-free via the Thomson set-top box; clean as a whistle. So effective is DTV in this respect that it must be regarded as a very good cost-effective option for those whose reception is weak or plagued with ghosts. The set top box is likely to be cheaper and much more effective than a major antenna installation and you get the other benefits of DTV as they are introduced. The accompanying photos show the dramatic improvement on SBS – it was very noisy on the analog signal and clean as a whistle on the digital.

Of course, Pay TV would be another option for those who have ghost-ridden or weak reception. However my experience shows that the free-to-air stations are OK via Pay TV (Optus or Foxtel) but still not first class – low level ghosting is often still present!

In other respects though, the picture quality was a little disappointing. It is still not quite equivalent to a first-class off-air broadcast or to a good DVD. There is not quite enough definition or contrast – the pictures seemed a little washed out to me. The exception was ABC TV where the digital picture was clearly very good – almost to DVD standard.

It is also apparent that the compression techniques do lead to some funny picture anomalies whereby the main image sometimes seems to lose definition when there is rapid motion involved and also there are occasionally bits of the picture out of place.

Both Channel 10 and SBS had some experimental HDTV broadcast signals on one of their channels and these were shown as out of sequence frames – quite odd to watch as it was accompanied by chopped sound as well. Of course, there is no way of watching HDTV signals at present since there are no HDTV monitors or receivers available.

Interestingly, SBS also had two foreign language radio broadcasts.

Summing up

So far then, there is not a lot to excite as far as digital TV broadcasts are concerned. The Thomson Digital Set Top Box certainly works well and as noted above, if you are in a weak reception area, it may be a very effective alternative to a bigger antenna installation. It also cures ghosting completely.

If you want more information and a demonstration of the Thomson Digital Set Top Box, go to any of the Dick Smith Electronics PowerHouse stores. They can supply the unit at $698.00.

Sydney Area Digital Broadcasts

Identifier	Channel & Middle Frequency	Transmitter Location	Start Date
Digital 7	VHF6 – 177.5MHz	Artarmon	1/1/01
Digital 9	VHF8 - 191.625MHz	Willoughby	1/1/01
Digital 10	VHF11 – 219.5MHz	Artarmon	1/1/01
Digital ABC	VHF12 – 226.5MHz	Gore Hill	1/1/01
Digital SBS	UHF34 – 571.5MHz	Gore Hill	1/1/01

This panel shows the transmitter frequencies and locations for the Sydney area. This information can be seen for all areas in Australia by going to the website www.dba.org.au/reception/ This site also gives some program information. More information is available on the ABA site at www.aba.gov.au/what/digital/technical although it does appear that it has not been updated recently. Note that the new digital transmitters are in the VHF band, channels 6, 8, 11 & 12. So what happened about the plan to move all stations into the UHF band?

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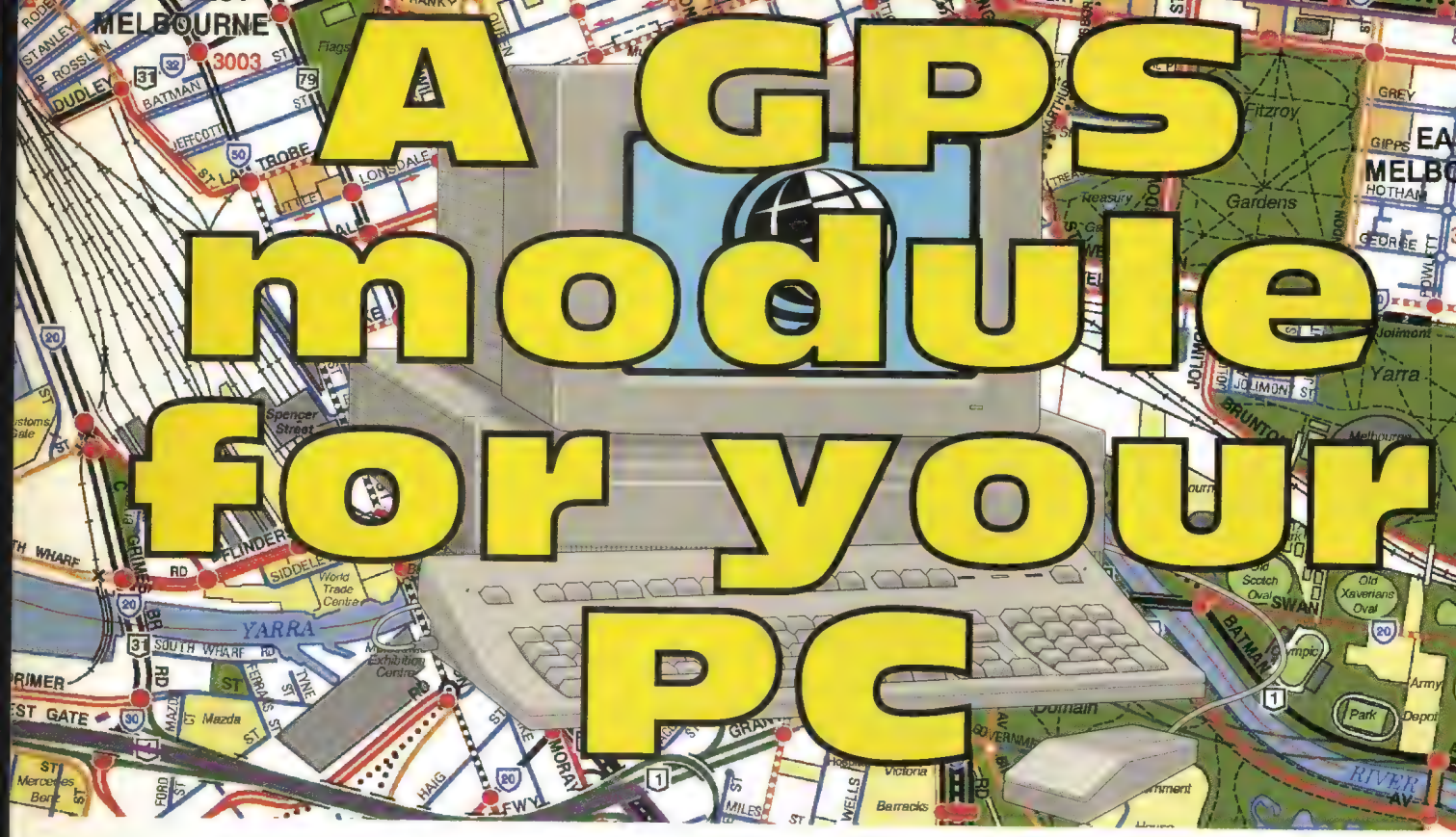
A GPS module for your PC



You can buy excellent – and reasonably cheap – hand-held GPS units these days. So why would you want to add GPS to a PC? The applications, as they say in the classics, are limited only by your imagination!

Most people are familiar with GPS: the Global Positioning System run by the United States Government. It allows a GPS receiver to locate its position anywhere on the planet by analysing signals received from a series of orbiting satellites. (For a more detailed explanation of GPS, see the separate panel in this article).

Quite a number of hand-held receivers are available at reasonable prices. These show your position as a latitude and longitude on an LCD readout. They're ideal for bushwalkers, hikers, etc – and fishermen love them because they can get back to that secret spot – exactly!

Some of the higher end models allow the position to be displayed on a map along with other numerous features.

But what if you'd like to interface a GPS directly to your PC or laptop?

Most of the cheaper hand-held units don't support an external interface at all – or if they do, it is an expensive option.

There is also the question of battery life (which is normally quite short anyway). If you'd like extended logging of data, you're up for yet another add-on for external power, not to mention an external antenna if it's not convenient to mount the entire unit in a spot that gives good coverage.

As you can imagine the task of tracking and analysing signals received from the up-to-12 satellites that can be in view at a single time is quite a complex task.

Fortunately quite a number of OEM (original equipment manufacturer) GPS modules are available that perform most of the real work and interfacing one of these modules to a PC or other serial device is quite easy.

This article describes constructing such a unit at a cost considerably less than using a hand-held unit and gives some pointers on getting some usable data out of the GPS module once it's built.

Why do it?

Linking a GPS unit to a personal computer is very much the doorway to countless other applications.

We are not even going to try to list those applications but anyone who has ever needed to know where something/someone was at any particular time, where it/they went from there, how long it took it/them to get there and so on . . . they are the types of applications which immediately spring to mind.

Having a GPS unit in your hand will tell you where you are (it's great

By PETER JOHNSON

The GPS interface sitting on the keyboard of a notebook PC. It's actually upside down so you can see the GPS module itself (right side of board). The active antenna lead connects on the right side, while RS232 data goes off to a suitable COM port via the socket on the left.

if you're lost!). Feeding that data into a PC then allows it to become really useful!

Still not convinced? OK, here's one application: rally driving. The GPS unit would know *exactly* where the vehicle is and, with the right software, a notebook PC could "tell" the driver (ie, in actual speech), what grade corner is coming up, what direction it takes, obstacles en route, etc. It would be far more accurate than any human navigator and wouldn't make "ouch" mistakes!

Another? How about delivery drivers, with all "drops" preprogrammed in to the notebook PC?

Circuit description

The circuit (Fig.1) is quite straightforward as the GPS module undertakes most of the "real work". All we require to interface it is a suitable power supply and a circuit to convert the TTL serial levels used by the board to the RS-232 levels used by a PC.

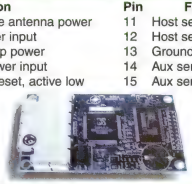
REG1 is a LM-2940CT-5 linear regular used in a standard configuration to provide the +5V required by the GPS module and active GPS antenna. Note that the GPS module consumes around 250mA of current when in operation so if the unit is to be operated from an input voltage much above the 6V recommended a heatsink will be required to dissipate the heat.

IC1, a MAX232, performs conversion from the TTL levels used by the GPS module to RS-232 levels for the external interface.

As well as containing a DC-DC converter to increase the voltage levels, the MAX232 also provides 15kV of ESD (electrostatic discharge) protection on the RS-232 interface to pro-

Table 1 – Laipac TF10 GPS Receiver Module Connections

Pin	Function	Pin	Function
1	+5V DC Active antenna power	11	Host serial data output A
2	+5V DC Power input	12	Host serial data input A
3	Battery backup power	13	Ground
4	+3.3V DC Power input	14	Aux serial data output B
5	Push-button reset, active low	15	Aux serial data input B (DGPS)
6	Reserved	16	Ground
7	Reserved	17	Reserved
8	Reserved	18	Ground
9	Reserved	19	1 PPS time mark
10	Ground	20	Reserved



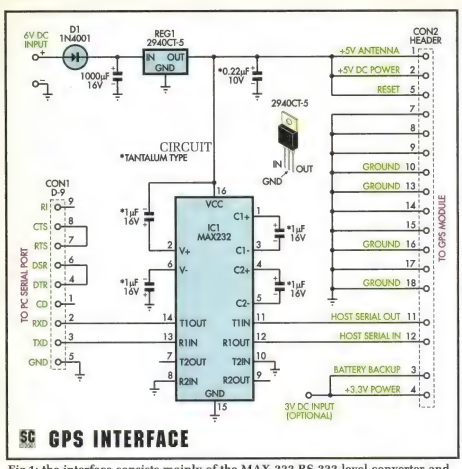


Fig.1: the interface consists mainly of the MAX-232 RS-232 level converter and a few power supply components. Battery backup is optional, especially if the unit is to be continuously powered.

vide some level of protection to the expensive GPS module.

The GPS module itself plugs into connector J2 and performs forms the "brains" of the project. The board contains the RF front-end to receive the 1.575GHz signal from the GPS satellites and an on-board RISC processor running at around 50MIPS to calculate time differences between the received satellite signals and triangulate this into the latitude, longitude and altitude of the receiver.

The position information and a very accurate time (each satellite contains four atomic clocks) are available through the serial port.

The clock is also available as a series of 100ms TTL pulses at pin 19 with the time reference being the negative edge. The time is accurate to UTC within ±1µs.

The GPS module

The processed data is available on pin 11 of the module and is sent as NMEA sentences (see below) at 4800bps with 8 data bits and no parity. Pin-outs for the module are shown in Table 1.

Configuration commands may also be sent to the GPS module through pin 12, the host serial data input, although for most applications configuring the GPS module is not necessary as the default power-on "command set" instructs the GPS to send all the information necessary.

Astute readers will pick up that several connections on the PC board have been made to the reserved pins on the module. Why?

While the recommended module is the Laipac TF10 there is somewhat of an industry standard known as being "Rockwell Compatible" and these modules have similar pin configurations.

This design is capable of also working with most of these modules, although because of the large number of variants it is recommended you carefully check the data sheets before using a different module with this project.

For the same reason the project uses a double-sided PC board when single sided could have been used –some modules have the mounting connector reversed and require mounting on the top side of the PC board rather than the bottom.

While modules with the connector pointing towards the bottom of the module are probably the most popular, modules with the connector pointing to towards the component side are quite popular with some portable equipment manufacturers because

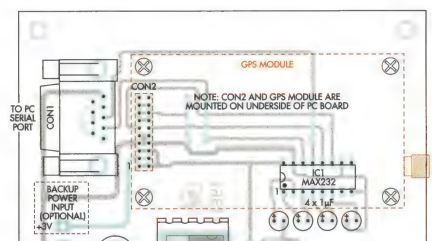
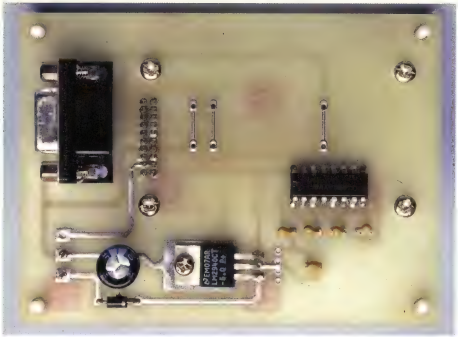


Fig. 2: the component overlay of the double-sided PC board, from the component side. The blue tracks are on the component side. This board is more complicated than it needs to be to allow alternate GPS modules to be fitted.



Looking straight down on the "normal" component side of this double-sided PC board: there's not much to solder here so you shouldn't have any problems. . .

Parts list

1 PC board, 108 x 80mm, double sided, code RCS PJGPS2K1
1 Laipac TF10 GPS module, SMA right angle, Type 4 OEM connector
1 20-pin (2x10) female straight header socket, 2mm centres
1 D-9 female connector, right-angle PC board mounting
1 3-way screw terminal, PC board mounting
1 TO220 mounting kit
1 3mm screw, 10mm long
4 3mm screws, 16mm long
5 3mm nuts
4 6mm Nylon spacers, 6mm long
4 PC board Nylon supports, 20mm long

Semiconductors

1 LM2940T-5 low dropout regulator (REG1)
1 Maxim MAX232N RS-232 level converter (IC1)
1 1N4004 diode (D1)

Capacitors

1 1000µF 16VW electrolytic (C1)
1 0.22µF 10VW tantalum (C2)
4 1µF 16VW tantalum (C3-6)

they make the design slightly more compact.

Construction

Mount the TF10 module on the bottom of the PC board!

I hope that's got your attention but if you're an advanced constructor you probably often skip the assembly instructions. It is the only assembly point that may be different to what you expect looking at the component overlay (Fig.2).

As noted the PC board may be used with a variety of GPS modules, but the TF10 module supplied with the kit must be mounted so that the socket points towards the solder layer of the board, or back the front to what would normally be expected.

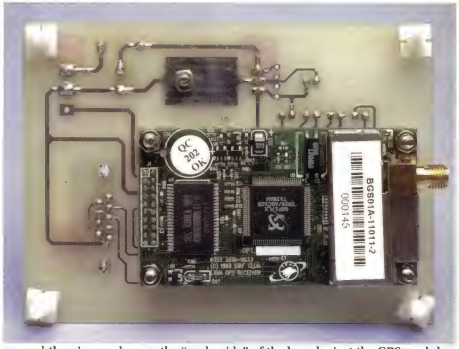
With a TF10 module you may like to consider using a socket for IC2, but with some other modules that mount on top of the PC board that may not leave enough clearance, so check the physical requirements of the particular module first.

Other than that normal construction methods apply. It will be easiest to start with the 20-pin GPS connector first, followed by the low-profile passive components such as the diode and five tantalums. Follow this with the voltage regulator, D-9 connector, MAX232 IC and finally the 1000µF electrolytic capacitor.

The TF10 module may secured to the board using nylon spacers of 6mm length and 6mm diameter, along with four 15 x 3mm steel screws. It is recommended however that the GPS board not be inserted until the testing procedure below has been followed.

Testing and final assembly

For initial testing leave the GPS board disconnected and apply 6-9V to the power connector. You will no-



. . . and there's even less on the "underside" of the board – just the GPS module which plugs into the socket you previously soldered underneath.

Table 2 – Example data received from GPS module

```
$GPRMC,040055.999,A,4250.5522,S,14718.4910,E,0.08,143.68,060101,,*11
$GPGGA,040055.999,4250.5522,S,14718.4910,E,1,08,1.3,58.9,M,,,,0000*25
$GPGLL,4250.5522,S,14718.4910,E,040055.999,A*20
$GPGSA,A,3,21,29,15,14,25,11,03,31,,,,,2.7,1.3,2.3*3B
$GPGSV,3,1,09,29,85,066,47,21,57,118,48,14,52,126,44,15,37,041,47*73
$GPGSV,3,2,09,31,31,278,46,11,30,231,47,03,20,325,48,25,13,010,44*73
$GPGSV,3,3,09,23,12,097,*4C
$GPVTG,143.68,T,,M,0.08,N,0.1,K*61
```

See Table 3 below for an example of interpreting the "GPRMC" sentence from the receiver that contains the time and position information. The example data is as per the first line shown above.

tice on the component overlay there are two power connections, +6V DC and battery backup.

The battery backup is optional and may be connected to a 3V battery to save the GPS almanac while the main power is off. This allows the unit to perform a quicker "warm start" when power is applied because the unit will have an idea where the satellites should be.

Battery backup is not necessary if you plan to have the main power source available constantly.

Use a multimeter to check that the voltage between pin 15 (GND) and pin 16 (Vcc) of IC1 is 5V (±0.25V), to confirm that the voltage regulator is operating correctly.

Once this has been confirmed give the board a quick check for any shorted tracks, install the GPS module and attempt to use the module as described below.

If at any stage you're unsure if the GPS module is operating correctly you can perform a "loop-back" test by removing the GPS module and inserting a piece of wire between pins 11 & 12 on the socket.

This will cause data received from the serial port to be sent back through the MAX232 chip to the serial port. You should be able to connect to the serial port with a communications program, such as HyperTerminal, and see that characters typed are received back.

Characters being echoed back should cease once the link is removed, otherwise you either have a short on the PC board or in the serial cable. This will confirm that the RS-232 converter is operating and the cable is connected to your PC correctly, although it will not help check the communications parameters are set correctly.

The active antenna

The recommended antenna is supplied with a 5m cable, making it more than long enough to reach, for example, a vehicle roof.

Speaking of that, best performance will be achieved if the antenna is mounted on a horizontal metal surface (such as a vehicle roof) to act as a ground plane. In fact, the antenna has a magnetic base to make mounting on a vehicle very easy.

If you cannot mount it on a ground plane you will probably still get adequate signal but it will take longer to

Table 3 - Interpreting the GPRMC sentence

DATA ELEMENT	DESCRIPTION
$GPRMC	Defines this record as "recommended minimum GPS data".
040055.999	UTC time in format hhmmss.sss. *The example record was received at 04:00:55 UTC (+99ms).*
A	"A" indicates valid position calculated, "V" indicates invalid position.
4250.5522	Latitude in format ddmm.mmmm. *To convert to the more common degrees, minutes seconds (°, ', ") format multiply the decimal part (0.5522) by 60 to get the seconds component. The example is 42°, 50', 33".*
S	S indicates south of the equator; N is north of the equator.
14718.4910	Longitude in format dddmm.mmmm. *Convert as for latitude giving 147°, 18' 29".*
E	E indicates east of the meridian, W indicates west.
0.08	Speed over ground in knots. *Multiply by 1.852 to get kilometres per hour.*
143.68	Course over ground in degrees. *Only accurate when the receiver is moving so bearing can be calculated from previous position.*
060101	UTC date in format DDMMYY, *The example is 6-Jan-2001.*
(empty)	Magnetic variation. *Not provided by TF10.*
*11	Checksum of the message in hexadecimal. *It is the 8-bit exclusive-OR of all characters between the "$" and "*" delimiters.*
CR/LF	Line is terminated with a carriage return/line feed combination.

Above is the recommended active GPS antenna, available from CommLink Solutions. Inset at right is the antenna from the opposite side.

initialise and the chances of errors in the data are higher.

Regardless of whether it is mounted on a ground plane or not, the antenna needs to be able to "see" a significant proportion of the sky with minimal obstruction from buildings, etc – if it cannot see the sky, it cannot see the satellites which it needs to receive data from.

As a rule of thumb, for best performance at least a third of the sky should be visible from the location you mount the antenna. That's not to say it won't work indoors – it possibly will, as long as you don't have a metal roof or metallised insulation blocking the incoming signals.

And note that if you move the antenna from one place to another without it being turned on, it may take a few minutes to store a new almanac and therefore allow valid data to be received. During this time you will receive only a series of zeros for latitude and longitude.

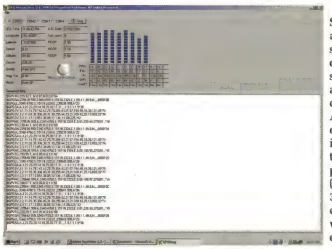
Connecting to the computer

The female D-9 connector on the board is configured as a DTE (data terminal equipment). This means the unit can be connected directly to the serial port on a PC with a straight-through cable.

Operation of the board with a modem will require a male-male null modem cable.

Data is sent at 4800bps with 8 data bits and no parity and can be received with any terminal emulator program such as HyperTerminal supplied with Windows.

Once the board is connected, powered up and the COM port selected you should see data being received. For a while it looks like gobbledegook then, as the antenna almanac builds, invalid data (0's for latitude and longitude) and finally, after perhaps a minute or so, (maybe more if it



Screen grab from the author's "GPSDiag" software showing data coming in from eleven satellites but only nine are used (data quality of others is too low). As the module needs only three data for an initial fix and one thereafter, the positional data (151°18'13.938" E, 33°40'28.56" S) and other information here would be regarded as extremely accurate.

Table 4 - Free/shareware GPS software on the Internet

commlinx.com.au/gps_diag.htm
Name: GPSDiag

Software written by the author using Borland Delphi that shows position information received from the module along with other information such as speed, altitude, satellite positions and signal strength. It also displays the raw data received and is mainly intended as a diagnostic tool to get started.

iliketheinternet.com/gps.html
Name: NMEAgent

Somewhat similar to the above but also allows gathering and averaging of positions over a long period to obtain a very accurate position of a fixed location.

maptrax.com.au/freestuff/
Name: Trax 2.2

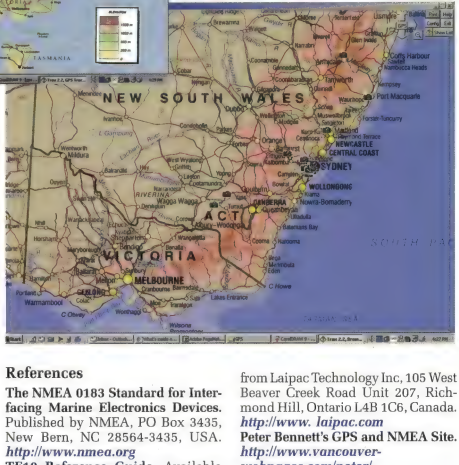
Australian-produced GPS mapping software that is easy to use and provides a map of Australia as part of the installation. The map provided doesn't contain a lot of detail but more detailed maps may be purchased. The software is fairly limited but it is an ideal starting point, being very easy to install and use.

gpsu.co.uk/index.html
Name: GPS Utility

When you want to get into the real stuff and start plotting your positions on a map, this seems to be the best package around. The free download has some limitations but at $US40 for the registered version it is excellent value for money and this package is much easier to set-up and use than others that provide as many features. It also works with a wide variety of maps and you can "register" your own bitmap, TIF and JPEG files by providing the known latitude and longitude of a few points on the map.

diku.dk/users/elgaard/eps/index.html Name: EPS – The Elgaard Positioning System

A Java-based GPS and mapping system. For those into Java this will provide an excellent starting point for other projects but probably won't be easy to follow for Java novices.



These two screen grabs are from the "TRAX 2.2" software (see overleaf). First screen actually shows the whole of Australia with Sydney targeted as our location (gee, just as well it got that right!). The black crosshairs and red concentric circles mark our position, while the blue arrow shows our "course" (obviously invalid 'cos our office isn't moving – we hope!) The second screen shows the only level of zoom possible with this demo software (yep, we're still in Sydney) but if we wanted purchased more maps, it could go down to street level. The camera images on the map below, by the way, show red light and fixed speed camera locations – your PC can even give you a voice warning as you approach these when mobile!

is the first time the unit has been turned on) data that looks something similar to that in Table 2 (and the screen grab overleaf).

The NMEA standard

Confused? Those familiar with GPS will immediately recognise the data in Table 2 as NMEA sentences.

This is the standard for GPS communications devised by the National Marine Electronics Association and is the universal standard describing how GPS devices should send data to a host, such as your PC.

The complete NMEA specification actually covers quite a range of marine related devices and as the document is copyright it must be purchased from the NMEA.

Fortunately many freely available sources describe the sentences that relate to GPS and such information is widely available on the Internet.

Try using your favourite Internet search page for the terms "NMEA" and "GPS" or alternatively the Internet site http://commlinx.com.au/NMEA_GPS.htm contains a good overview and examples of the sentences you'll most likely want to interpret.

Those who don't feel confident reading the NMEA specification and writing code to communicate with the module needn't feel intimidated. The 'net provides a plentiful source of "ready-to-go" solutions for GPS.

A few pointers to get you started are shown in Table 4 and in the references.

References

The NMEA 0183 Standard for Interfacing Marine Electronics Devices. Published by NMEA, PO Box 3435, New Bern, NC 28564-3435, USA. ***http://www.nmea.org***

TF10 Reference Guide. Available from Laipac Technology Inc, 105 West Beaver Creek Road Unit 207, Richmond Hill, Ontario L4B 1C6, Canada. ***http://www. laipac.com***

Peter Bennett's GPS and NMEA Site. ***http://www.vancouver-webpages.com/peter/***

Wheredyageddit?

CommLinx Solutions is the Australian distributor for Laipac GPS & Telephony products. The TF10 OEM GPS module is priced at $176 including GST. A suitable active GPS antenna with 2-metre lead and SMA connector is $49.95 including GST. A complete kit of components (not including antenna) is available for $247.50 including GST. See http://commlinx.com.au/products.htm for more details, fax orders to (03) 6273-5227 or write to CommLinx Solutions, 9 Wattle Avenue, Lutana, Tas, 7009.

The 20-pin OEM connector is also available from CommLinx Solutions for $5.00 including GST or can be obtained from Farnell electronics, part number 511407. Farnell orders can be placed at http://www.farnell.com.au or by calling 1300 361 005.

The PC board is produced by RCS Radio and is available as PCB 4981s. All other components are available from retail electronics distributors.

Global Positioning System

Like many of today's technology breakthroughs, GPS was originally a military system. Initially four NAVSTAR satellites, the first launched in 1978, formed the backbone of the system. As satellites go, they aren't very big: about 1.5m wide and 5m long. In orbit (17,450km out), they weigh only 850kg.

Each satellite contains four extremely accurate atomic clocks (one second in three million years!). This time information and satellite identification is transmitted on two L-band carriers around 1.575GHz.

Today there are 24 of these satellites which provide coverage to every point on the planet. At least three satellites would normally be "visible" from anywhere; more important areas have up to twelve satellites available from which to obtain data.

Because the exact position of each satellite is known at any instant in time, a GPS receiver on the ground (or in the air, or at sea) can work out precisely how far away that satellite is by comparing the time-stamped transmitted signal to the time it actually received that signal.

Doing the same thing with the signal from a second satellite enables the GPS receiver to determine its position between the two. Adding a third signal enables a location to be established; ie, a three-dimensional "fix".

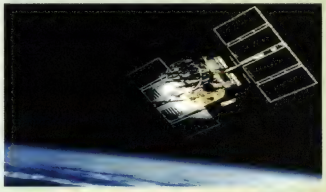
And adding a fourth signal (or more) enables errors to be virtually eliminated, giving even more accuracy.

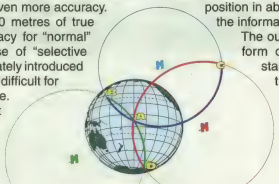
Design accuracy is within 30 metres of true position. Until last year, accuracy for "normal" users was only 100m because of "selective availability" or SA errors, deliberately introduced into the system to make it more difficult for non-friendly armed forces to use.

But former US President Clinton ordered SA be removed on 1st May 2000, to allow all users access to the military-precision signal.

Achieved accuracy is usually better than 30m – many vehicle identification and tracking systems claim to be able to show on which side of a road a vehicle is travelling or parked – an accuracy of at least 10m or even better. That's not too bad from 17,450km away!

The GPS system is fairly unaffected by weather; rain and cloud generally have little impact but wet foliage can cause problems. During the "Desert Storm" war in the Middle East ten years ago, GPS was used extensively to obtain positions in completely featureless desert and often in blinding sandstorms. In fact, GPS has been credited with having a decisive role in the UN forces' success.





Basic Positioning (simplified to one plane only): if the GPS receiver (at point A) knows it is a certain time away from the red satellite, it must be somewhere on the red circle. Similarly, if it also knows it is a certain time away from the blue satellite, it can only be where the red and blue circles intersect (points A & C). If a third (green) satellite is added, it can only be at point A. Once it knows it is at point A, even if the GPS receiver temporarily loses data from one or two satellites it knows it cannot be at points B, C or D so it takes its data from one satellite and works with that data until another comes into view. In the real GPS world, all of the circles are actually spheres, so the system operates in all three dimensions and can therefore give height.

Most of today's GPS receivers require an initial "fix" from no more than three satellites to establish their position – the Laipac TF10 module used in this project is one such device. Once the signal is received and position determined, it can keep accurate readings using only one satellite. Therefore it is ideal in very poor signal areas.

It can take almost a minute to receive and analyse enough signals to determine position from a "cold start". Once the receiver knows where it is, a "hot start" gives a position in about eight seconds. While operating, the information is updated about every 100ms.

The output from the module is data in the form of NMEA-0183 sentences. NMEA stands for the National Marine Electronics Association and has become the standard for all GPS data output. An NMEA sentence contains an address field, a data field and a checksum.

Within the data field can be such information as latitude and longitude, north or south of equator, east or west of 0° meridian, speed over ground in knots, course over ground in degrees true, the date and time, and whether the data is vaild or not.

By the way, the reason that the exact positions of the GPS satellites is always known is that they themselves use signals from the other satellites to exactly determine their own position.

And it's not only the US which has GPS satellites – in 1982, the Russians launched their own system called GLONASS. Some newer GPS receivers can operate using both NAVSTAR and GLONASS. **SC**

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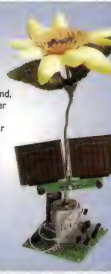

SILICON CHIP Mar '01 $49.80

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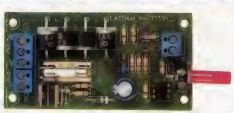

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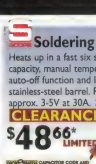

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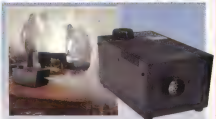

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That's where you go!

By JIM ROWE

Dr Video

An Easy-To-Build Video Stabiliser

Do the pictures on your TV or video projector jitter and jump around when you're trying to watch a movie on VHS or DVD? This is usually caused by the hidden pulses that are added to a lot of pre-recorded video software, to prevent illicit copying. Here's a low cost circuit that removes most of these nasties, cleaning up the video for more stable viewing.

YOU'RE PROBABLY AWARE that nowadays a lot of pre-recorded video software is "copy protected", to stop people from making their own pirate copies. In principle that's fair enough, too – having spent millions of bucks making a movie, the producers are entitled to get a fair return on their investment.

What complicates the situation is that the system that's used to prevent copying involves adding extra "dancing pulses" to the normal video signal. Unfortunately, this can stop quite a few TV sets and projectors from displaying a steady picture during legitimate viewing.

In particular, the extra pulses can cause problems with large-screen TVs that display the picture at 100 fields per second (100Hz) to reduce flicker and also with projectors that perform line and pixel doubling to improve picture clarity. They can cause problems with older conventional TV sets, too.

If you have one of these sets or projectors, often the only way to get a steady picture is to somehow remove those extra pulses. The idea is to "clean up" the video and let the set's sync circuitry do its normal job without interference. And that's exactly what this little project is designed to do.

Note that once the offending pulses are removed, it may also become possible to record the video. However, we want to stress that this project is NOT designed to allow recording – it's intended purely to allow you to achieve stable and steady pictures for viewing. It is illegal to record copyright material and there are heavy penalties for doing this. We must therefore warn you specifically against using the project to do so.

As well as removing most of the copy protection pulses, Dr Video also allows you to apply a small amount of high-frequency boost to the video, to "sharpen" the picture a little when you're watching movies on older VHS tapes (which are often a little "soft"). However, you can switch off this sharpening when it's not needed – when you're watching DVDs, for example (these are usually quite sharp enough already).

Dr Video is housed in a compact low-profile instrument box, and runs from a nominal 12V DC source – such as a battery or plugpack. You should also be able to build it for considerably less than other stabilisers.

How it works

Before we look at the circuit diagram, it may help if I explain a little about the copy protection pulses we're trying to remove. By the way, we're talking here about the pulses added to video signals in the Macrovision copy protection system, as this is the one most commonly used.

To thwart illicit recording, the Macrovision system adds three main sets of pulses to the video signal – two of them essentially combined. First, there's the "dancing" pulses, which are added to as many as 14 of the normally "black" lines which follow the vertical sync pulse "block", in the vertical blanking interval (VBI). This is a group of lines that correspond to the vertical retrace time, when the scanning electron beam in the picture tube is being returned from the bottom of the screen back to the top, to begin the next video field.

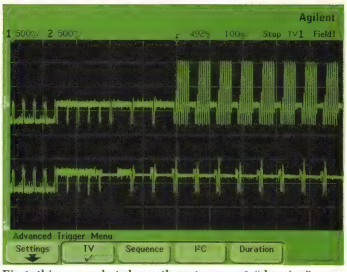


Fig.1: this scope shot shows the extra sync & "dancing" pulses (righthand end of top trace) that are added following the vertical sync block. These pulses constantly change amplitude.

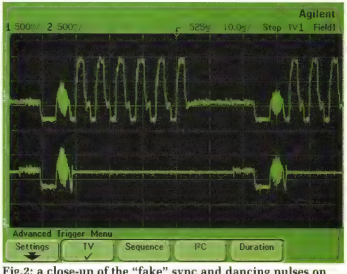


Fig.2: a close-up of the "fake" sync and dancing pulses on one of the lines in the vertical blanking interval.

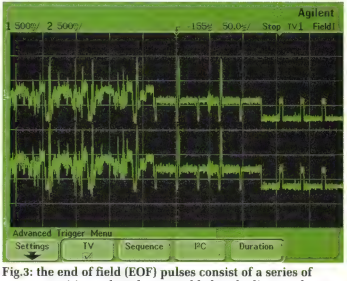


Fig.3: the end of field (EOF) pulses consist of a series of narrow positive pulses that are added to the lines at the very bottom of the picture.

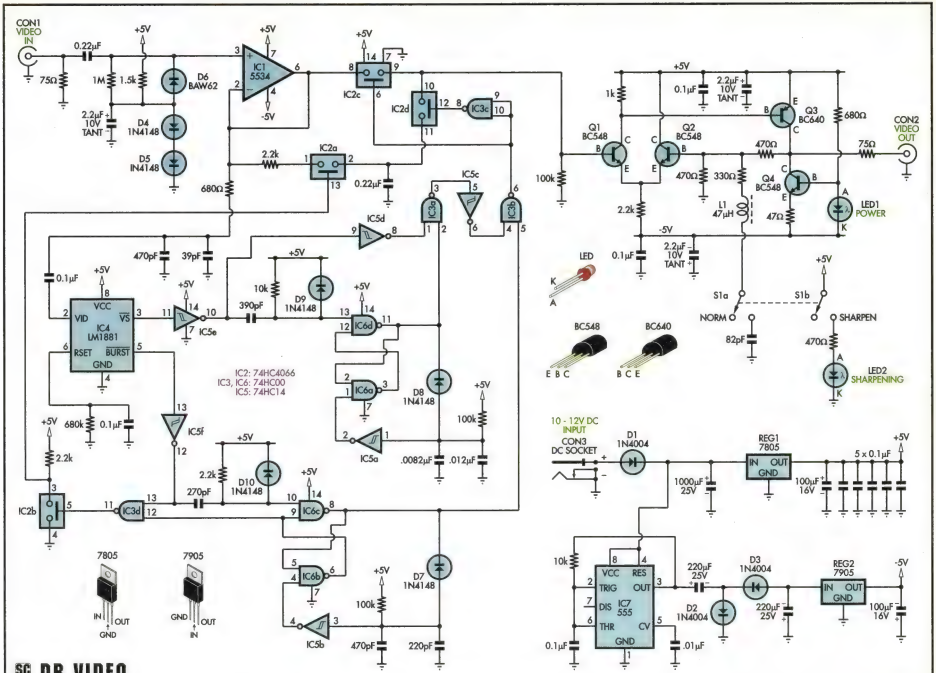

CON1 VIDEO IN
75Ω
0.22µF
1M
1.5k
2.2µF 10V TANT
D4 1N4148
D5 1N4148
D6 BAW62
+5V
-5V
IC1 5534
2.2k
680Ω
IC2a
IC2c
IC2d
IC3c
0.22µF
IC5c
IC5d
IC5b
IC5a
470pF
39pF
0.1µF
IC4 LM1881
VCC
VID
VS
RSET
BURST
GND
IC5e
10k
390pF
D9 1N4148
IC6d
IC6a
D8 1N4148
100k
.0082µF
.012µF
IC2: 74HC4066
IC3, IC6: 74HC00
IC5: 74HC14
680k
IC5f
IC2b
IC3d
IC6c
2.2k
270pF
D10 1N4148
IC6b
IC5b
D7 1N4148
470pF
220pF
7805
7905
IN
OUT
GND
SC 2001 DR VIDEO
Q1 BC548
Q2 BC548
Q3 BC640
Q4 BC548
1k
2.2µF 10V TANT
680Ω
470Ω
330Ω
L1 47µH
47Ω
CON2 VIDEO OUT
75Ω
LED1 POWER
LED
S1a
S1b
NORM
SHARPEN
82pF
470Ω
LED2 SHARPENING
BC548
BC640
E B C
B C E
10 - 12V DC INPUT
CON3 DC SOCKET
D1 1N4004
REG1 7805
1000µF 25V
100µF 16V
5 x 0.1µF
IC7 555
VCC
RES
TRIG
OUT
DIS
THR
CV
220µF 25V
D3 1N4004
D2 1N4004
REG2 7905
.01µF

Fig.4 (left): the circuit diagram for the Dr Video. Sync separator IC4 and its associated circuits generate gating signals which operate CMOS switches IC2c and IC2d, to strip off any extra sync and dancing pulses present on the vertical blanking interval lines.

To each of these 14 or so VBI lines, the Macrovision system adds as many as seven extra "fake" horizontal sync pulses, each of which is immediately followed by a short "fake video bar" pulse – which can have an amplitude anywhere between black and peak white. And it's these "fake video bar" pulses which slowly vary up and down in amplitude or "dance", usually in two or three groups.

Figs.1 & 2 show the details of this. The top trace in Fig.1 shows the groups of pulses on eight lines after the vertical sync block, while Fig.2 is a close-up of the pulses on one line.

In theory, these VBI pulses shouldn't upset the operation of the sync separator circuit in a TV or projector – but they are intended to play havoc with the sync locking servo and recording level AGC circuitry of a video recorder. In particular, the extra sync pulses muck up the sync locking, while the "dancing video bars" fool the recorder's AGC circuitry into varying the recording gain up and down to compensate. All of which they indeed do but unfortunately the havoc isn't restricted just to VCRs!

The remaining set of pulses that are added into the video signal are the so-called "EOF" or end-of-field pulses. These consist of a series of narrow positive pulses which are added to the lines at the very bottom of the picture and are timed to coincide with the colour synchronising "bursts" (ie, they are inserted just after the horizontal sync pulses). In effect, these pulses push the colour bursts for these lines right up into the peak white region, so that the black level and colour locking circuitry of a VCR are again tricked.

Fig.3 shows what the EOF pulses look like on an oscilloscope.

The EOF pulses are considerably harder to remove than the fake sync and dancing-video-bar pulses in the VBI group. Luckily, though, they don't seem to cause nearly as much havoc with TV sets and projectors as the VBI pulses. So in the Dr Video project, we take the same practical approach adopted in many other video stabilisers: we concentrate on removing the VBI pulses and allow the relatively innocuous EOF pulses to remain.

By now, you should have a good idea as to what we're trying to achieve in the Dr Video circuit. Now let's see how it's done.

Circuit details

Fig.4 shows the full circuit of the Dr Video project. It might look a bit complex at first glance but it's really not as bad as it looks. We'll describe it section by section.

The incoming video arrives at CON1, where we terminate it with the correct 75Ω load. We then couple it to the non-inverting input (pin 3) of IC1, a 5534 op amp used here as a wideband video input buffer.

The 0.22µF coupling capacitor removes any DC component in the incoming video and, together with the 1MΩ resistor and BAW62 diode, forms a simple "DC restorer". This clamps the sync pulse level to about 0.6V above ground. (D4 and D5 produce a DC level of 1.2V but this is offset by a drop of 0.6V in D6).

IC1 is connected as a voltage follower with a gain of one, so a replica of the incoming video therefore ap-

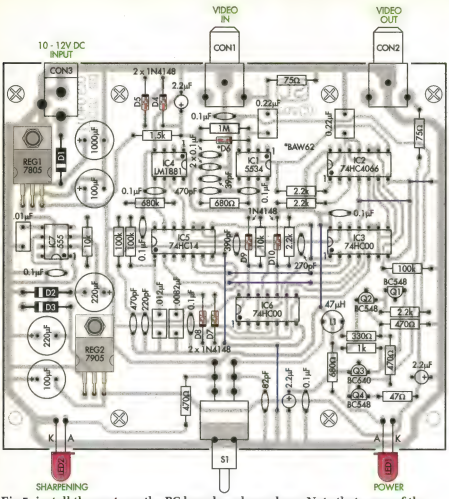


Fig.5: install the parts on the PC board as shown here. Note that some of the links are quite close to each other so use insulated wire for these. Note that the ICs don't all face in the same direction.

pears at its output (pin 6). This signal is then taken in three directions. We'll look at two of these shortly but first we'll concentrate on the path that leads down via the 680Ω resistor. As you can see, this feeds the video signal to the input of IC4 (via a 0.1µF capacitor.

IC4 is a very handy LM1881 video sync separator chip. The 680Ω series resistor and paralleled 470pF and 39pF capacitors to ground form a low-pass filter, to "lose" the signal's colour information (which can disturb the LM1881's operation). The 0.1µF coupling capacitor simply blocks the DC component, while the 680kΩ and 0.1µF capacitor from pin 6 of the LM1881 to ground set the chip's internal timing circuitry for accurate and stable sync separation.

The LM1881 provides a number of outputs but here we only need two of them. First, from pin 3, we get a negative-going vertical sync pulse about 230µs wide. Second, pin 5 gives a series of narrow pulses (again negative-going) which correspond to the video signal's colour sync bursts – ie, "burst gating" pulses.

Next, we invert both these pulses using IC5e and IC5f, to convert them into positive-going form. We then pass them through differentiator circuits, to obtain narrow negative-going pulses derived from their trailing edges. For the vertical sync pulses this is done by the 390pF capacitor, 10kΩ resistor and D9, while for the burst gating pulses it's done by the 270pF capacitor, 2.2kΩ resistor and D10.

Each of these narrow pulses is then used to trigger a simple non-retriggerable monostable or "one shot" circuit, to produce longer pulses of carefully set length. Each one-shot consists of a flip-flop formed by two cross-coupled NAND gate elements, plus an RC timing circuit and a Schmitt inverter.

The one-shot formed by IC6d, IC6a and IC5a is used to produce a pulse about 1.1ms long, starting at the end of the vertical sync pulse from IC4. The end of this output pulse corresponds closely with the end of the VBI, so therefore it "covers" all of the lines which should ideally be "black" but can have added Macrovision nasties.

The second one-shot formed by IC6c, IC6b and IC5b is used to produce a much shorter pulse, about 50µs long, starting at the end of each colour burst gating pulse from IC4. This one-shot's output pulse therefore lasts for most of the "active" part of each horizontal line, and certainly "covers" that part of the VBI lines where the extra sync and "dancing" pulses occur.

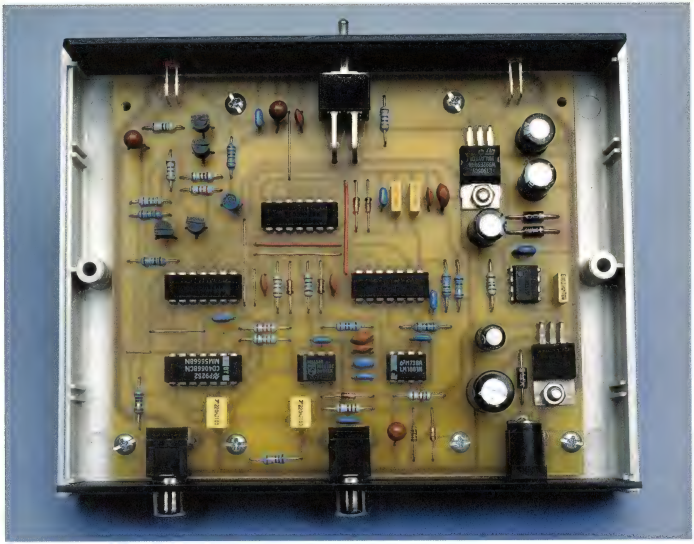
As you can see, the output of the upper one-shot is then gated with an inverted version of the vertical sync pulse from IC5e using NAND gate IC3a – which together with IC5c forms a positive-logic AND gate. This gating is done because the LM1881 can itself be disturbed by the Macrovision pulses, which occasionally cause its vertical sync pulse output from pin 3 to begin early.

This can in turn cause our one-shot to trigger early. However, the gating ensures that if this occurs, the one-shot's output pulse is "blocked off" until the end of the vertical sync block. (We don't want to change this part of the video signal, of course).

So the output from IC5c is a pulse which is "high" for all of the lines between the end of the vertical sync pulse and the end of the VBI. And this is gated with the 50µs pulses from the lower one-shot using NAND gate IC3b. This means that the output of IC3b will go low for the active part of each line between the end of the vertical sync pulse and the end of the VBI – but ONLY for those lines.

We'll get back to these pulses shortly. For the moment, though, let's turn our attention to NAND gate IC3d. As you can see, one input of this gate is fed with the positive-going burst gating pulses from IC5f, while the other input receives a negative-going 50µs pulse from the output of IC6b, in the lower one-shot. What's the idea of this gating?

Again, it's needed because of the way that the LM1881 (IC4) can itself be upset by the Macrovision pulses. In this case, "extra" burst gating output pulses can be produced during the active part of the VBI lines, at some points in the "dancing pulses" cycle. By using IC3d to gate the burst



Everything fits on the PC board, so there is no external wiring to the front panel components or to the sockets on the rear panel.

pulses with the complementary output of the 50µs one-shot, we make sure that these unwanted extra pulses are "gated out". As a result, the output of IC3d only goes low for the 12µs duration of the "real" colour bursts.

IC3d's output is used to drive the gate of analog bipolar switch IC2b. This switch is used as a simple pulse inverter, with its "output" pin connected to the +5V supply via a 2.2kΩ resistor. So the output (pin 3) provides a train of positive-going burst gating pulses. These in turn are used to turn on switch IC2a, which therefore conducts during the colour burst period of every video line. And when IC2a turns on, it allows the following 0.22µF capacitor to charge via the 2.2kΩ resistor, to the current average value of the video signal from IC1.

Why on earth is this done? Well, by convention, the average value of a video signal during the colour bursts is used to establish the signal's black/blanking level. So by turning IC2a on only during the burst periods, we ensure that the 0.22µF capacitor charges to a voltage which corresponds closely to the video signal's black level.

The last step

Right, so now we have the 0.22µF capacitor providing a black level voltage, plus some pulses available from IC3b which go low only during the active part of the VBI lines. The last step in cleaning up the video signal is to put these pulses to work.

As shown on Fig.4, the pulses from IC3b are fed directly to the gate of analog switch IC2c, which is in series with the "top" video path from IC1. As a result, IC2c will be turned off during the active part of the VBI lines but left on at all other times.

At the same time, IC3c is used to invert the pulses from IC3b and supply these to the gate of CMOS switch IC2d – which is connected between the output of IC2c and the 0.22µF capacitor. This means that when IC2c is turned off to block the video, during the active part of the VBI lines, IC2d is turned on to clamp the video output to black level.

Still with me? Essentially, all of the circuitry around IC3, IC4, IC5 and IC6 acts to produce some fast gating signals. These signals operate CMOS switches IC2c and IC2d, to strip off any extra sync and dancing video pulses present on the VBI lines and turn the lines back into nice plain black. As a result, we get a "cleaned up" video signal across the 100kΩ resistor at the output of IC2c and IC2d.

Output amplifier

The circuitry to the right of the 100kΩ resistor is a wideband video output buffer amplifier, with transis-

The rear panel carries two RCA sockets (Video Out & Video In) plus a 2.5mm DC panel socket for the external plugpack supply.

tors Q1 and Q2 forming the input stage and Q3 the output stage. Q4 forms a constant current load for Q3, to allow it to drive a relatively low impedance external load via a 75Ω series or "back terminating" resistor. Note that the reference voltage for the base of Q4 is established by the "power" LED (LED1), which therefore also acts as a pseudo-zener reference diode.

The voltage gain of the output buffer amplifier needs to be 2.0, to compensate for the loss in the back terminating resistor. This gain is set by the two 470Ω resistors, which provide negative feedback to the base of Q2. However, as you can see, there's also a 330Ω resistor, connected via a 47µH RF inductor to one of the poles of switch S1.

When S1 is switched to the "Sharpen" position, an 82pF capacitor is connected to the inductor, forming a series resonant circuit at about 2MHz. The "Q" is quite low though, because of the series 330Ω resistor. As a result we only get a "boost" of about 4dB – enough to give a useful amount of sharpening to a "soft" video picture.

The second pole of S1 is used to turn on a second indicator LED (LED2), to show when this sharpening is taking place.

Power supply

The sync separator chip (IC4) and most of the logic circuitry operates from +5V DC, while the input and output video amplifiers run from ±5V. As a result, the power supply is fairly straightforward, since we can easily derive these rails from any suitable source of 10-12V DC.

Diode D1 is connected in series with the supply input, to protect the circuit against reverse polarity damage. This then feeds a 1000µF filter capacitor and a 3-terminal regulator (REG1), which provides the +5V supply rail. This rail is filtered using a 100µF ca-

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	1	680kΩ	blue grey yellow brown	blue grey black orange brown
❑	3	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	10kΩ	brown black orange brown	brown black black red brown
❑	4	2.2kΩ	red red red brown	red red black brown brown
❑	1	1.5kΩ	brown green red brown	brown green black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	2	680Ω	blue grey brown brown	blue grey black black brown
❑	3	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	330Ω	orange orange brown brown	orange orange black black brown
❑	2	75Ω	violet green black brown	violet green black gold brown
❑	1	47Ω	yellow violet black brown	yellow violet black gold brown

Table 2: Capacitor Codes

Value	IEC Code	EIA Code
0.22µF	224	220n
0.1µF	104	100n
.012µF	123	12n
.01µF	103	10n
.0082µF	822	8n2
470pF	471	470p
390pF	391	390p
270pF	271	270p
220pF	221	220p
82pF	82	82p
39pF	39	39p

pacitor plus several 0.1µF bypass capacitors scattered around the circuit.

The -5V supply rail is produced using 555 timer IC7. This is used as a self-oscillating "commutator switch" and drives a "charge pump" rectifier circuit consisting of D2, D3 and the two 220µF capacitors. This produces a source of unregulated -10V DC, which is then passed through 3-terminal regulator REG2 to produce the -5V rail.

In this case, we can use such a simple charge-pump circuit to generate the negative rail because the current needed from it is quite low.

Construction

Building the Dr Video project is very straightforward since all the parts are mounted on a PC board coded 02104011 (117 x 112mm). This board assembly fits snugly into a standard low-profile plastic instrument box measuring 140 x 110 x 35mm.

The front panel is anything but intimidating. There's only one control (ie, the Normal/Sharpen switch S1) plus the Power and Sharpening indicator LEDs. On the rear panel, there's just the video input and output sockets, plus the DC input connector. All these connectors mount on the PC board, along with S1 and the two LEDs, so there is no off-board wiring at all.

Fig.5 shows the assembly details. There are eight wire links on the board and it's probably a good idea to fit these first. You can use tinned copper wire for many of these, although I suggest you use insulated wire for at least one link where there are two running close together (just to the left of IC6, for example). This will help prevent unwanted shorts.

Next, I suggest you mount the DC input connector and the two video sockets. Note that the holes for these may need enlarging slightly with a jeweller's rat-tail file before the connector lugs will fit through. Make sure the connectors are bedded down squarely against the top of the board before you solder the lugs to the board pads.

Switch S1 can also be mounted at this stage. Push is down squarely against the board before soldering its leads and don't forget the two "hold down" lugs near the front of the switch (these lugs stop the switch from moving when it is operated).

With this done, you can add the various electronic parts, in the usual order. Start with the resistors and small capacitors, then fit the diodes and electrolytic capacitors – taking care with their polarity.

The next stage involves fitting the transistors and ICs, again taking care with their polarity. As usual, take steps to minimise the risk of ESD (electrostatic discharge) damage when handling and fitting the CMOS devices in particular. Use an earthed soldering iron and wear a wrist-grounding strap if you like. You should also solder the supply and ground pins of each IC to the board pads first, before soldering the remaining pins.

Use a 10mm long M3 machine screw and nut to secure the positive regulator (REG1) – this device does get warm and the screw and nut provide a small amount of heatsinking in conjunction with the board copper. It isn't strictly necessary to do this for REG2, as this device runs virtually cold. However, it's still a good idea to secure it, just to stop it "flapping around" and placing strain on the solder joints.

Finally, fit the two LEDs. Note that these mount in mirror image fashion, with the longer anode lead of each towards S1 in the centre of the board. They should initially be soldered in vertically, with the bottom of each LED about 15mm above the board.

After soldering, each pair of leads is bent forwards by 90° about 7.5mm up from the board, so that the LEDs can be pushed into matching front panel holes.

Final assembly

The front and rear panels for this project will be supplied pre-punched, with screened lettering. These panels can now be fitted to the PC board

Parts List

1 PC board, code 02104011, 117 x 112mm
1 low-profile plastic instrument case, 140 x 110 x 35mm
1 miniature DPDT toggle switch, 90° PC-mounting (S1)
2 RCA sockets, 90° PC mounting
1 2.5mm DC connector, 90° PC-mounting (CON3)
2 M3 x 8mm machine screws, with M3 nuts
6 small self-tapping screws, 6mm long
1 47µH RF inductor (L1)

Semiconductors

1 NE5534 op amp (IC1)
1 74HC4066 quad switch (IC2)
2 74HC00 quad NAND gates (IC3,6)
1 LM1881 video sync separator (IC4)
1 74HC14 hex Schmitt inverter (IC5)
1 LM555 timer (IC7)
1 7805 5V regulator (REG1)
1 7905 -5V regulator (REG2)
3 BC548 NPN transistors (Q1,Q2,Q4)
1 BC640 PNP transistor (Q3)
2 3mm red LEDs (LED1-LED2)
3 1N4001 or 1N4004 power diodes (D1-D3)
6 1N4148 diodes (D4-5, D7-10)
1 BAW62 fast switching diode (D6)

Capacitors

1 1000µF 25VW PC electrolytic
2 220µF 25VW PC electrolytic
2 100µF 16VW PC electrolytic
3 2.2µF TAG tantalum
2 0.22µF MKT polyester
10 0.1µF monolithic ceramic
1 .012µF MKT polyester
1 .01µF MKT polyester
1 .0082µF MKT polyester
2 470pF ceramic
1 390pF ceramic
1 270pF ceramic
1 220pF ceramic
1 82pF NPO ceramic
1 39pF NPO ceramic

Resistors (0.25W, 1%)

1 1MΩ	1 1kΩ
1 680kΩ	2 680Ω
3 100kΩ	3 470Ω
2 10kΩ	1 330Ω
4 2.2kΩ	2 75Ω
1 1.5kΩ	1 47Ω

hardware and the entire assembly installed in the bottom half of the case. The panels slide into the moulded case slots, while the board is secured using 6mm long self-tapping screws which mate with matching plastic spigots in the base.

A total of eight 3mm mounting holes are provided in the board pattern and you can fit screws to all eight if you wish. It's a certainly a good idea to fit the four along the back, to anchor the board firmly so that it doesn't move when plugs are fitted to or removed from the sockets. On the other hand, two mounting screws will be quite sufficient at the front.

Your Dr Video should now be ready for checkout.

Checkout time

There's no actual setting-up required for this project. However, it's a good idea to check that the power supply circuits are working correctly before you fit the top cover and put it to work.

First of all, try applying 12V DC to the power input from a battery or plugpack supply. The Power LED should glow fairly brightly and the Sharpening LED should also light when S1 is switched to the "Sharpen" position. If one or both LEDs don't glow, remove the power immediately and investigate because you have a problem.

If neither LED glows, your 12V DC source may be connected with reverse polarity so that diode D1 is preventing any current flow. Reversing the supply connections will fix this problem.

If only one LED refuses to glow, the odds are that it's fitted to the board the wrong way around. So check this possibility first and correct the problem if necessary.

If you need to, the +5V and -5V supply rails can be checked with a multimeter. Both rails should be within a few tens of millivolts of their nominal values.

If the positive rail is fine but the negative rail isn't, look for a fault in the circuitry around IC7 and REG2. You may have fitted one of the electrolytic capacitors or diodes D2 & D3 the wrong way around. Another possibility is a solder bridge that's preventing IC7 from oscillating.

If the LEDs glow as they should and the two 5V supply rails measure correctly, your Dr Video is probably working fine and is ready for business.

As mentioned earlier, there are no setting-up adjustments, because in this project we're relying on close tolerance resistors and parallel capacitor combinations to ensure that the only parts of the circuit that are "critical" function as they should. We're confident that this should be the case with almost any combination of components.

Problems & cures

There are only two possible problems that we can envisage, neither of them very likely. One is that if the timing components attached to the input (pin 1) of IC5a (in the VBI one-shot) are all excessively high in value, you may see a few black lines at the extreme top of the picture – and then only with movies in "full screen" format, as opposed to widescreen/letterbox. If this happens, it can easily be fixed by replacing the .0082µF capacitor with one of lower value (say .0068µF).

The other equally faint possibility is that if the same component tolerance problem should occur in the timing circuit for the "burst gate" one-shot (ie, at the input of IC5b), the output pulses from this one-shot might be extended enough so that switches IC2c and IC2d begin to damage the horizontal sync pulses – causing horizontal jitter or tearing. This is most unlikely to happen but if it should, the remedy would be to replace the 220pF capacitor with a smaller one (ie, 180pF).

One final comment – if you want to change the amount of high frequency video boosting given by the "Sharpen" switch, or the actual peaking frequency, this is easy to do. The amount of boosting is set by the series resistor, so varying it up or down in value from 330Ω will reduce or increase the boosting respectively.

Similarly, the peaking frequency is set by the series capacitor, which can be changed from the current 82pF if you wish. A smaller value will increase the frequency and vice-versa.

Where To Buy The Kit

The copyright on this project is owned by Jaycar who will have complete kits available shortly after publication. these kits will include pre-punched front and rear panels with screened lettering.

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FROM THE PUBLISHERS OF "SILICON CHIP"

SERVICEMAN'S LOG

"OK, you fix it, big shot"

"Two heads are better than one – even if one is only a sheep's head." Or so says the popular adage. So don't scorn a second "head" when the going gets tough. You might be the sheep's head.

That preamble was inspired by my first story this month. It concerns a Sony KV-T25SZ8 with a BG-1S chassis, which came to me from an agency. This model is only three years old and looks brand new except perhaps for it's styling – it is black plastic instead of the current silver look.

The complaint written on the service card said "dead". Well, it wasn't; at least not completely. Switching it on, the set fired up and with an antenna connected, even gave forth sound – until it cut out a few seconds later. Using the RM870 remote control, it could be switched on again immediately and the stations selected but it closed down again shortly afterwards. By doing this a few times, coaxing the tube to warm up, I managed to get a white line at the top of the TV screen but it still closed down.

I was discussing this with a colleague as we shared a brew of morning coffee. He reckoned the fault was a flashover in the picture tube – one of a batch of tubes used in this model, and which was supposedly faulty. I thought otherwise, having had a similar set give the same symptoms. That set was a KV-G21S1 with the same chassis, and the cause was the vertical output IC, IC551, and pincushion control amplifier, IC801.

Well, we argued back and forth but the set wasn't being fixed and, as my coffee was finished, I whipped the back off and had a poke about. My friend kept reminding me that this was a well known fault – but that didn't explain the line at the top of the screen.

I pulled out the file on the BG-1S chassis to find the circuit for this model. Unfortunately, I had only the one for the KV-T25SF8, as well as for the set I had fixed before. The first thing I noticed was that the jungle chip IC300 was now a TDA8375A instead of TDA8366N3D but pin 50 was still the EHT X-ray protector, which I unsoldered.

This allowed me to switch the set on without it closing down – but I had to keep an eye on it. If something serious was causing it to close down, this was now free to vent its wrath on associated components! On the other hand, this gave the tube a chance to warm up properly and I could see that there was about 100mm of somewhat distorted scanned raster at the top of the screen. But there was no sign of distress – heat, smoke, or whatever – from the rest of the set. Whatever was crook wasn't effecting anything else at present.

I followed the X-ray protection line and found that, by desoldering zener diode D1505 and resoldering pin 50, the set would remain on but with the same fault. This suggested that the fault was in the vertical deflection and correction circuits.

I measured the main supply rails to IC551 (LA7830) and IC801 (5PC4558G2-E – surface mount) to find them spot on at -13V and +15V, so I confidently ordered these two devices on spec.

I WAS DISCUSSING THIS WITH A COLLEAGUE AS WE DRANK OUR MORNING COFFEE...

I fitted the parts when they arrived, one at a time, only to find that they made no difference.

"I told you so", my friend said, when I acquainted him with this development.

"OK, you fix it, big shot" I retorted.

"Well, all right – let me have a squiz at it".

There were a lot of "ers" and "ums" coming out of him for the next half hour. That will keep him out of trouble for a while I thought, while I went on to the next job.

But give him his due, he solved the problem in one go – and within that half-hour – but he did have to bring in the heavy artillery; ie, the oscilloscope.

And he now conceded that a flashover seemed unlikely, since the set continued to function without any sign of sparking. His first step was to measure the voltage on all the pins of the vertical output and pincushion ICs and he found them to be correct.

So the CRO was brought in. This revealed that there was a nice clean vertical sawtooth on pin 46 of the jungle IC, the vertical positive output, but nothing so clean was arriving at IC801 or IC551. Following this path it appeared to go crook at D315, a 9.1V zener. Removing this established that it was leaky. Replacing it fixed the problem.

I have to admit that the man appears to be a genius – give him a beer! (Of course, I had done all the spade work first. He was just dotting the i's and crossing the t's. Ahem!).

Now, what was that I was saying about a sheep's head?

The Sanyo VCR

My next story involves quite a change of scene. Tony Black came in looking as white as a sheet. He was clutching a VCR but somehow I didn't think that was the cause. Tony is a young farmer who lives at the back of Woop-Woop and drives an extremely dodgy Kingswood wagon.

"What's the matter?" I asked. "It's those truck drivers," he finally gasped. "What about them?" I enquired. "I've just had a whole lot of them monster me up the highway. I was driving at 110km/h and they were still right on my rear end all the away".

I soothed him down and carefully removed the VCR from his white knuckles. Obviously, the truckies had scared him, as they do everybody, and having come this far, it would have been a pity to drop the VCR, a Sanyo VHR-190.

After a suitable interval, I asked what was wrong with it. As he described it, it died every time a tape was put into it. I told him to leave it with me and I would check it out. I didn't know what to suggest about the speeding truckies; his story reminded me very much of Spielberg's "Duel" sequence. A newer, faster car might be one way but if one is at the speed limit and the truckies drive well over the limit, what does one do? Pull over and let them pass, I guess.

Items Covered This Month

- Sony KV-T25SZ8 TV set (BG-1S chassis).
- Sanyo VHR-190 VCR.
- Sony Playstation.
- Mitsubishi CT-2804AST (ST) TV set (ASV664 chassis).

Back at the bench, I removed the covers, and could see his description of the fault to be quite accurate. This model has been quite successful and employs the Sanyo P88 deck but this unit is getting on a bit now.

I didn't have the service manual for this set and was disinclined to buy one because of its age but the problem looked to be a power supply fault, probably due to leaky electros and a low power rail.

I could see that the loading motor was working but I made a note that I should change the belts anyway. I spoke to Tony about it, emphasising how old it was and, with new ones starting at less than $250, it was hardly worth it. Anyway he started bleating about needing a new car that he couldn't afford and could I please see what I could do?

How do I get myself into such situations? I had listened to him whinging about the truckies and had become distracted.

To tackle the power supply, I would

really need a circuit. I could buy one of course but hopefully I would be able to beg, borrow, or steal one from the opposition.

In the meantime, I needed replace those two belts anyway. The one underneath the deck was easy but the top one was difficult, not only because access is poor but because the loading gears have to be dismantled and can easily be reassembled incorrectly, giving horrible timing problems and jamming the eject mechanism completely.

Firstly, the PC boards, which partly cover the loading motor assembly, have to be removed. Then, making sure the deck is in the full unloaded and ejected mode, you remove three small screws, release a white plastic cam and finally remove the squirrel gears. (It is a good idea to mark these with a felt tip pen to ensure they are reassembled in exactly the same position). The next problem is to remove the belt – to save time, I just cut it. To fit the new one over the lower pulley is fiddly and a tight fit. Wetting it with metho can sometimes make it easier.

When the belt is on, one has to reassemble the rest in the reverse order, making sure the ejector hasn't moved and is still in its maximum eject position.

Fortunately, and probably due to experience, everything went well until I tested it. Initially it wouldn't work at all but this was because the belt was slipping over the metho. When it evaporated and the belt gripped, not only did it load and play but also it performed all its functions without stopping or turning off.

What a bonus – the power supply didn't need attention after all. Presumably, the stretched belt was slipping and, as a result, the loading sequence was not being completed within the required time and the system would shut down.

When I told Tony, he was delighted and now has a few more pennies towards a new car.

Sony Playstations

And now a few thoughts on Sony Playstations. I have had several through the workshop over the last couple of years, initially for modifications to play overseas games.

As the supply of chips has dried up and newer models are now available, the emphasis has been more in repairing the power supplies, in particular the SCPH-700Z. More often than not, the repairs have been straightforward in this simple switchmode power supply. If fuse F001 is blown, for example, the problem is normally confined to a diode in the bridge rectifier; eg, D002 being short circuit. Replacing it with an 1N4007 usually solves this.

More elaborate failures will sometimes take out the FET. If the power supply looks otherwise immaculate and it won't go, switch it off and check

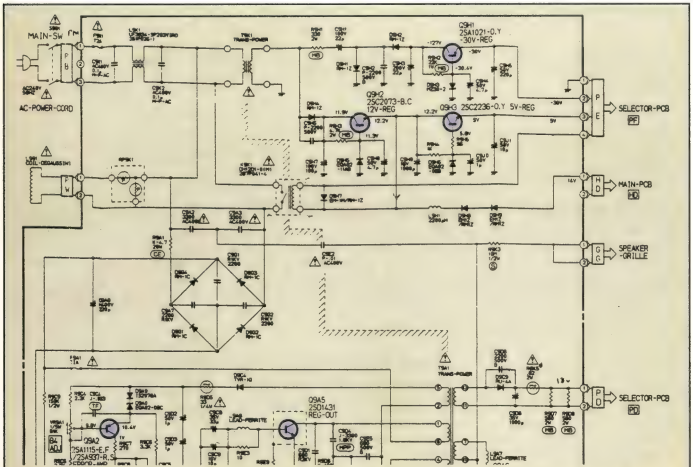


Fig.1: the switched mode power supply circuit in the Mitsubishi CT-2804AST. Note the relay-drive line to pin 4 of connector P E.

for 325V on the main electrolytic. If the voltage is still there and not decaying rapidly it can be assumed the start-up resistor R003 (820kΩ) has gone high. Make sure that you discharge the capacitor before replacing R003.

Mitsubishi TV set

Mrs Thompson's Mitsubishi 1988 CT-2804AST (ST) ASV664 chassis had ceased to function after a power surge from a recent storm. Unfortunately, she didn't have household contents insurance and was also an old-age pensioner. It was my task, therefore, to resurrect her dead set for as little as possible. It also had to be done in the workshop because, when I called, I had noticed there were a few burnt patches of components on the separate power supply board, implying a fairly extensive failure.

The power supply is a dual one – there is a main switchmode power supply providing 115V and 18V, and a secondary one employing a small 50Hz transformer (T9K1), providing 5V, 30V and 14V rails. The secondary supply has to operate first in order to activate a relay which operates from the 14V rail.

When the relay closes and the set fires, the relay voltage is supplemented by one from the horizontal output transformer (pin 4 of connector PE, which mates with connector PF on the selector board, and the collector of the relay-drive transistor, Q702).

But the relay wasn't working, simply because there was no 14V to operate it. In fact, none of these rails was working. And, in turn, this was because the primary of mains transformer T9K1 was open circuit. This is a small PC-mounted transformer which, unfortunately, is no longer available as a spare part. The secondary supplies a voltage doubler via R9H1 and C9H1 to the collector of Q9H1, which is a voltage regulator delivering 30V. This secondary winding also applies 12V to the collector of Q9H2 via D9H4.

So what was the secondary voltage supposed to be? It had to be at least 12V but it could be higher. Eventually, I settled for 12V and bought a conventional 300mA transformer, which mounted well where the old one had been. I also replaced a few dodgy looking electros on the secondary and I now had the voltage for the relay and could switch on the other power supply.

This now produced the 18V supply but there was no 115V rail from the emitter of Q9A6. That left only the area around Q9A6 and Q9A7. And this was one of the areas that was burnt. Resistor R9E1, the two transistors, three electros and diode D9D1, all needed replacing

Once this was done, the whole set fired up and there was picture and sound.

Everything appeared to be fine, except for the -30V rail, which was down to -22V. I then found that the voltage on the collector of Q9H1 was low at the same voltage; ie, -22V. I spent some time checking all the parts in this circuit before concluding that perhaps my choice of power transformer hadn't been the best.

I phoned technical support at Mitsubishi to find that the secondary of the transformer should really be 24V and not 12V. However, if I substituted a 24V transformer, it would no longer fit on the PC board and it would be a messy repair. The other two rails and associated circuits were functioning correctly and I pondered what to do.

In the end, I decided to leave it as it was – the -30V rail is used only for memory on IV702 M58659P (pin 2) and the set was remembering everything perfectly so I figured it was best left alone.

Mrs Thompson was relieved to have her set back, and the bill wasn't too heavy. **SC**

Dolby 5.1 digital and audio, front panel controls, infrared . . .

Sound Blaster Live! Platinum 5.1

There would hardly be a computer sold these days without a sound card – even many business applications need sound. You can pay as little as thirty dollars or so for a generic sound card – or you can spend around $499 and get what many regard as one of the best.

Review by Ross Tester

Most of the sound cards these days advertise one particular feature: "Sound Blaster Compatible". If they're all trying to emulate a Sound Blaster, doesn't that mean that the genuine Sound Blaster must be the yardstick by which all cards are judged?

It might be possible to buy sound cards which have more (or should that be different?) features. But then again, the Sound Blaster Live! Platinum 5.1 we are looking at here doesn't lack anything, at least anything that we would find important. And as Creative Technology (the manufacturers) state, over one hundred million satisfied users worldwide can hardly be wrong.

Sound Blaster Live! Platinum 5.1 is, as its name suggests, a 5.1 channel surround sound system. What the name doesn't say is that it is Dolby Digital 5.1 – there is no need to buy a Dolby Digital decoder to experience Dolby surround sound because it's already in your system.

So if you want to get into home theatre, this could be a very good way to do so. The system will handle both CD-ROM and DVD-ROM so you will have the audio side well and truly taken care of. You even get remote control – but we're getting ahead of ourselves.

Apart from the fact that it is so powerful, arguably the best feature of the Sound Blaster Live! Platinum 5.1 is the front-of-computer "Live!Drive IR", which allows connectivity and infrared control where you want it: out front! It's shown enlarged below.

What's in the box?

It's a big box. But we've opened

Here's what you get: the sound card itself is on the left side with the infrared remote below it. On the right is the Live!Drive IR unit together with the assortment of cables. The microphone is partially obscured (in front of the box) underneath which is the set of seven CDs and "getting started" instructions.

some big boxes before to find lots and lots of polystyrene packaging and not much content. Not so this one: there's lots of content!

First of all is the sound card itself – a PCI-slot card about 135 x 100mm. As sound cards go, it's about average size. And like most cards, it has a backplane with the usual line in, line out, microphone and joystick sockets. You start to think something is a little different when you discover that it also has a "rear out" socket and what's called an "analog/digital out" jack. If you've worked out that these are for surround sound (analog or digital), you're one jump ahead of us!

The card itself also has many more on-board connectors than your typical sound card. Of course there is the standard CD Audio connector – but there's also an Aux connector (used for other devices within the computer which produce audio such as TV tuners, MPEG, etc); a TAD (telephone answering device) connector which provides a mono connection from a standard voice modem and transmits microphone signals to the modem; a CD SPDIF connector for the SPDIF (digital audio) output if available from a CD-ROM or DVD-ROM drive; and finally, an audio extension (digital I/O) connector which connects the card to an optional digital I/O card or to the supplied Live! Drive IR.

Ah, the Live! Drive IR. We were coming to that. What absolutely infuriates most PC users is the fact that all connections to the machine are on the rear panel. And as most users like to keep their machines neat and wiring tucked away, to make even a minor change – connect a different input device to the sound card, for example – requires major deconstruction of your workstation or work area.

Creative Technology have cleverly overcome this problem with the use of the Live! Drive IR. This is a standard-width (5-1/4in), half-height box which fits into any free drive bay on the front panel – in fact, it screws into place just like a CD-ROM or hard disk drive.

On the Live! Drive IR fascia, you get a pair of RCA "aux in" sockets which can be used for just about any consumer equipment stereo audio output, a 1/4-inch headphone socket

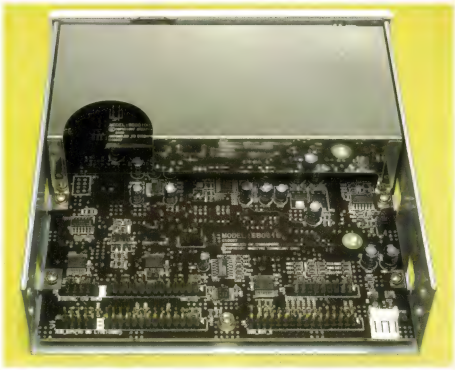
(unusual, that!) with its own volume control, a 1/4-inch line in or mic in stereo or mono socket (again with its own level control), a pair of RCA SPDIF in/out jacks (for digital audio from DAT or minidisc) along with a pair of optical SPDIF in/out connectors and a pair of MIDI in/out connectors.

That gives you a large – and thorough – array of sound sources from which to choose. One thing we didn't mention on this fascia is an infrared receiver window which is used in conjunction with the comprehensive infrared remote controller, also supplied with the Live! Drive IR unit.

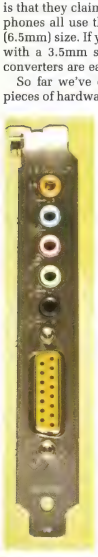
It's hard to overstate the importance – in our eyes, anyway (or should that be ears?) – of this Live Drive IR. It's been one of our biggest headaches over the years and now, at least as far as the audio is concerned, we'll never have to move the computer again!

By the way, the reason Creative use 1/4-inch sockets for the headphones is that they claim better quality headphones all use the standard 1/4-inch (6.5mm) size. If you have headphones with a 3.5mm socket, 3.5 to 6.5mm converters are easily obtainable.

So far we've only looked at three pieces of hardware in the box. There's also a range of inter-connecting cables (some of which you use during installation) and some of which you may use later (such as the MIDI and optical cables). Finally, at least as far as the hardware is concerned, there is a microphone and desk stand which can be used in conjunction with several items of software including internet connectivity.



The Live! Drive IR unit is not just a patch board. There's a lot of electronics crammed onto its PC board as well, as this rear photo shows. This unit is the same size as a CD-ROM or 5-1/4inch hard disk drive and screws in the same way.



Looking at the back plane (attached to the sound card) we can see the extra sockets which make all the difference: the top socket is the analog/digital out, for use with 5.1 channel amplifiers or digital speakers. Below that are the line in, microphone in, line out and rear speaker output jacks, with the joystick/MIDI "D" connector at the bottom. This photo is approxim-ately life size.

The software

Sound Blaster Live! Platinum 5.1 includes no less than seven software CDs. The first of these is used for installation, which itself is a fairly simple procedure. It will run on any Pentium 166 or higher with 32MB RAM (64MB recommended) and operates under Windows 95, 98, 2000, ME or NT4. Some of the games require a faster machine with plenty of hard disk space (eg, 300MB!).

The software loads the according-to-Creative "revolutionary" EMU-10K1 digital audio processor, unleashing more power than you'll know what to do with (at least for the first few weeks!). It also loads EAX, a collection of audio technologies developed by Creative to deliver 3D audio technology and 5.1 analog and digital sound.

Just some of the packaged software includes:

- **Creative PlayCenter 2** – provides fast encoding and decoding of MP3 and WMA files, rips music from CD tracks, customizes and compiles playlists and so on.
- **Mixman Studio** – create your own music, choosing sounds from the Soundisc library or create your own audio files to use in the mix.
- **Sound Forge XP** – puts powerful audio processing tools to work on your desktop. Edit and record digital audio (.WAV) files.
- **PixMaker (and PixScreen)** – lets you create 360 degree interactive PixAround scenes and web pages with hotspots to audio and video.
- **Creative MediaRing Talk** – internet voice communication software which allows you to make PC to PC calls over the internet.
- **Steinberg's Cubasis VST, WaveLab Lite and ReCycle Lite**
- **Vorton Technologies' Kool Karaoke**
- **Mindmaker's Prody Parrot**
- **Mindmaker's Game Commander SE**

The five other CDs load a variety of games and applications. The games including Interplay's MDK2, Thief II and Deus EX. While they looked pretty interesting, I didn't even attempt to try out the games, due to lack of time.

Besides, the boss might think I was having fun. . .

Setup

I mentioned a moment ago that setup was easy – which strictly speaking is true. It was more the pre-setup which concerns me – what is not said, rather than what is said.

At the start of this review, I mentioned that the vast majority of (virtually all) computers sold these days would have sound cards fitted – as did mine.

As I opened the Sound Blaster package I thought to myself "what about the existing sound card". But I could find no mention of such an animal in the instructions. I knew that I should remove the existing card both electronically (through add/remove hardware under Control Panel) and physically, by removing it from its slot.

But then I thought "hey, I'm reviewing this as a typical computer user. I should follow instructions to the letter". So I did and, of course, things didn't work the way they were supposed to. It was strange – some things sort-of-worked, others didn't work at all but my existing sound card did keep working. No conflicts were shown – things just weren't quite right.

Anyway, I thought "enough" and uninstalled both the Sound Blaster Live! Platinum 5.1 AND my existing card, removed the existing card and then re-installed the SBL!P5.1 – and surprise, surprise. It worked!

That's not the only beef I have with the installation instructions. No, I wasn't caught – but only because I've done this before.

The step-by-step instructions show you how to remove the front panel cover for the Live! Drive IR, how to install it and the sound card with diagrams showing how everything is wired together, then finally how to replace the computer cover, plug the power cord back in and switch on the system.

The very next page shows how to connect your CD-ROM or DVD-ROM drive to the card. Hey guys, we've just put the cover back on and powered up the system. So you have to power down, unscrew the case, connect the CD-ROM – then put the cover back on. OK, it's a small point but it's sloppy.

In use

This might sound a little strange in this review but we didn't have a 5.1 channel amplifier and speakers lying idly by, so we were unable to put the system through its full paces. All we were able to do was work in 2-channel mode.

The infrared remote control gives you virtually the same power as keyboard commands or mouse clicks. Unfortunately we found it a tad tricky to use.

And for this, we can say the system did everything we wanted it to do, albeit with some fairly steep learning curves. Given more time, we're certain we'd be able to get more from it – a LOT more. You can select two channel, four channel or six (5.1) channel mode.

We used the PlayCentre II software to rip audio from a few CDs and assemble playlists of our favourite tracks. We're not going to tell you that we then sent this across our network to a CD-ROM burner to make a "favourites" CD, because that could be illegal (but gee it worked well!).

We played with the effects engines, the mixers and many of the other applications – and loved 'em. It's fairly easy to grasp the fundamentals but you will need some time (and possibly the brain of a 10-year-old!) to really get into the nitty gritty. From the things we played with, though, the immense potential of the system was very evident.

We were unable to test the optical in/out because we had nothing which provided optical output or input. And we didn't put any of the internet applications to work because we operate through a network and a firewall – and every time I fire up a new internet application, "something screwy" happens to our internet server. So I left that well alone.

What we didn't like

Overall, our impression was very favourable. It packs a lot of punch and we're sure would give first-rate results as a 5.1 system. But there were just a couple of niggly little things . . .

Some of the applications literally take control of your PC and the limited instructions don't really give you enough info to claim it back. So be prepared to get a little frustrated from time to time (I know I did).

For example, once I had a large digital clock on screen (I don't know where it came from!) which I simply couldn't remove; even the main Creative Launcher doesn't have the familiar "–□x" box. Why not?

In time, I'm sure this would become less of a problem as you became more and more familiar with the software and the way it works.

Another thing was the inconsistency in the way the infrared controller worked. Sometimes it did what we expected, other times it didn't. Again, I suspect this is more a lack of knowledge or understanding on my part than anything wrong with the system but when you have limited time, it's a bit annoying.

And one curious feature I found with the infrared which I'm sure is not a problem with me(!): when you use it, then change buttons, the first step it takes is from the previous button pressed. For example, when you increase volume, then push the decrease volume button, the first thing it does is increase volume one more step before starting to decrease. Curious, that.

Where from?

The Creative Sound Blaster Live! Platinum 5.1 should be available from any reasonable computer store.

Trade enquiries should be directed to Creative Labs Pty Ltd, Locked Bag 5000, Banksmeadow, NSW 2019. Phone (02) 9666 6100; Fax (02) 9666 6900; website www.australia.creative.com. **SC**

Want to do your own home wiring? Repair appliances? Replace a power point or light fitting?

YOU can help make it happen!

Ever since the subject was first raised in SILICON CHIP, readers have been asking how we in Australia could convince our politicians to change the rules which currently make it illegal for most people to even remove the screws in a light fitting or power point so they can paint under it!

Here's your opportunity to help change the rules so that anyone who feels competent can **legally** do their own electrical wiring, just as they have done for years in New Zealand and many other countries.

We need to abolish the "closed shop" that state governments around Australia are presently maintaining through restrictive state legislation.

Photocopy the "Statement of Will" form, insert the name of your state in each of the spaces provided, and circulate it among your friends, family and workplace colleagues. Ask each signatory to circulate additional copies among their friends and family, etc.

If you have sufficient commitment to the cause, obtain signatures in public places, such as shopping areas, entries to train stations, etc. This is, after all, an issue of democracy that concerns not only electrical and electronic engineers, technical officers, technicians and hobbyists, but all householders. We must aim for a maximum number of signatories if we are to be successful.

Send the completed forms to SILICON CHIP and we will forward them to the relevant state Ministers, along with copies of published correspondence, editorials, etc. The Ministers will be informed that their response, or a report that they apparently decided not to respond, will be published in SILICON CHIP!

While in some ways similar to a petition, it must be our aim that it is not treated as a petition. If you have access to the Internet, go to http://www.rag.org.au/rag/petqld.htm and study the onerous requirements that must, by law, be observed in order to produce a petition that a state parliament will accept. Then click on Creative Petitioning at the bottom of the page to learn how easily parliaments can disregard petitions.

Our state parliaments have refused to accept petitions that had many tens of thousands of signatures on them, simply because the form of the petition was not exactly correct. If you don't have access to the Internet, suffice to say that conventional petitions to our state and federal parliaments are largely a waste of time.

In addition to circulating the "Statement of Will" form, write an individual "MY WILL" letter, similar to the one below, to your local state member of parliament and encourage others to do the same.

Don't forget to date the letter and provide your name and address so the parliamentarian can confirm that you are a constituent.

Dear Sir (or Dear Madam),

I know that it is my duty to keep you informed of MY WILL on any matter that comes before Parliament, or that should come before Parliament.

IT IS MY WILL that you take immediate action to end the "closed shop" that electricians enjoy in relation to "electrical work", and that you promote the replacement of current electricity related legislation with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.

Yours Faithfully,

(signed)

Above all, don't enter into written argument with a politician. Politicians are masters in the art of avoiding what they don't want to face up to, and become experts in manipulating words to their own benefit. Should your parliamentary member try to sidestep (and they are extremely adept at doing so) taking positive political action on your behalf (ie, they rattle on about what his/her party is or is not doing instead of agreeing to act in accordance with your WILL), you simply write back and state:

Dear Sir (or Dear Madam),

*Further to my letter of (insert date of your original letter) and your reply of (insert date of their inadequate or fob-off reply), and in accordance with my lawful obligation to keep you informed of MY WILL, I **again** inform you that IT IS MY WILL that you take immediate action to end the "closed shop" that electricians enjoy in relation to "electrical work", and that you promote the replacement of current electricity related legislation with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.*

Yours faithfully,

(signed)

If you have access to the internet, go to http://www.rag.org.au/rag/mywillet.htm and learn about the background and potential power of the "MY WILL" letter. For each "MY WILL" letter you send to your parliamentary member, send a copy to SILICON CHIP so we can monitor the level of involvement in the campaign for reform.

If your local parliamentarian shows interest in the issue, provide them with copies of relevant SILICON CHIP published correspondence and editorials, etc, or ask them to contact SILICON CHIP directly.

Come on SILICON CHIP readers, you asked us to help you with this one – if you don't want more and more restrictions, get those signatures rolling in!

Statement of Will: Reform of Electrical Legislation

The primary responsibility of parliamentary representatives and governments is to do ***the will of the people****. Electors must make* ***their will*** *known to their parliamentary representatives and governments.*

We, the undersigned, hereby assert ***that it is our will*** *that the government of *_____ acknowledge that current electrical safety legislation unjustifiably discriminates against ordinary householders as well as electrical and electronic engineers, technical officers, and technicians and that the effect of its enactment has been, and continues to be, to protect a monopoly for licensed electricians.*

We also hereby assert ***that it is our will*** *that the government of *_____ acknowledge that the potential dangers of "electrical work" are grossly exaggerated by the state electrical licensing boards and that the New Zealand electrical fatalities and accidents statistics belie these claims of dangers.*

We further assert ***that it is our will*** *that the government of *_____ repeal, in a timely manner, all current electrical safety legislation to replace it with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows ordinary householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.* ** (insert state or territory)*

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Jazz up your music with this TREMOLO

Add another popular effect to your music-making with this easy-to-build Tremolo unit. It features low distortion and extremely low noise, thus providing a very clean sound.

By JOHN CLARKE

Musicians and particularly guitarists often have a myriad of effects units attached to their equipment. They can switch these in and out at will, so as to add various effects while playing a particular section in the music. This low-cost Tremolo unit will add another effect to your repertoire and can be used simultaneously with other effects units.

The Tremolo effect is one which has been with us for a long time and is easily implemented using electronic circuitry. It is achieved simply by rapidly varying the volume over time. If these volume changes occur at a reasonably fast rate (eg, 5Hz), then the effect is quite noticeable. The amount of volume change (or depth) also determines the degree of the effect.

Effects units usually include several controls so that you can tailor the sound to suit your requirements. This unit has two controls – one to adjust the modulation depth and the other to adjust the rate of modulation or the frequency. You can also switch the effect in or out at will, using either a front panel switch or an external foot switch which plugs into a jack socket on the rear panel.

The unit is housed in a compact case with the input and output jack sockets at the rear. The front panel controls are quite simple and include an on/off switch, the Rate and Depth potentiometers and an In/Out switch.

A front-panel LED which flashes in sympathy with the volume modulation indicates the Tremolo rate, while

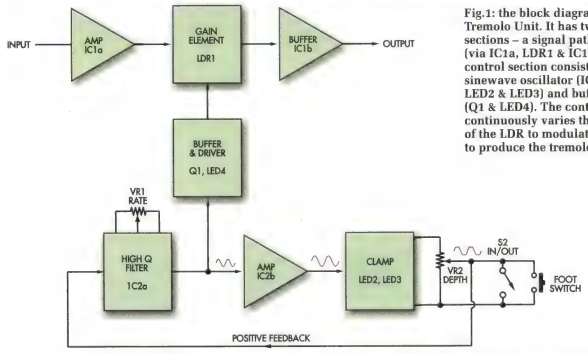


Fig.1: the block diagram of the Tremolo Unit. It has two distinct sections – a signal path section (via IC1a, LDR1 & IC1b) and a control section consisting of a sinewave oscillator (IC2a, IC2b, LED2 & LED3) and buffer stage (Q1 & LED4). The control section continuously varies the resistance of the LDR to modulate the signal to produce the tremolo effect.

a second LED provides power on/off indication. The unit is powered by a 12VDC plugpack supply.

Block diagram

Fig.1 shows the general arrangement of the Tremolo Unit. It has two distinct sections, one being the signal path and the other the control section.

As shown, the incoming signal is first amplified by IC1a and then fed to a gain element stage (LDR1). This stage varies the signal level at its output in response to a signal from the control section before feeding it to an output buffer stage (IC1b).

Normally, with no tremolo, the gain element provides a small amount of attenuation. When the tremolo effect is switched in, the gain of this stage is continuously varied, so that the signal is constantly boosted and cut. The gain of IC1a is such that the signal level remains constant when the tremolo effect is switched off.

The gain element itself is nothing more than a light dependent resistor (LDR) which varies its resistance according to the light that falls on it. In this circuit, we use a high-brightness red LED to control the LDR and this is driven by a sinewave signal that's generated by the control circuit.

The control circuit is basically a sinewave oscillator and consists of a high-Q filter stage (IC2a), op amp IC2b and a "clamping" stage. Also included are the depth pot (VR2) and the In/Out switch (S2). The sinewave output is buffered by transistor Q1 which in turn drives LED4 to control the amount of light falling on the LDR.

The oscillator operates by amplifying the signal from the high-Q filter, clamping this to produce a square wave and then reapplying the signal back to the filter via a positive feedback path. The high-Q filter produces a very clean sinewave at its output while the level is set by the square wave level (ie, the feedback signal), which in turn is set by depth pot VR2.

Main Features

- Adjustable tremolo rate
- Adjustable tremolo depth
- Tremolo rate indicator LED
- In/out switch on front panel and socket for a foot switch
- Compact size
- Operates from a 12VDC plugpack supply

Circuit details

Refer now to Fig.2 for the full circuit details. It's relatively simple and is based on five op amp stages.

Specifications

Total harmonic distortion ..... 0.1% at 100mV in and @ 1kHz

Signal to noise ratio ..... 108dB with respect to 1V input and 1kΩ input loading; 112dB A weighted

Maximum input before clipping ..... 1.2V RMS (12VDC input supply)

Frequency response ..... -0.1dB at 20Hz; -3dB at 34kHz

Signal gain ..... 1V in for 1V out with no tremolo modulation

Tremolo frequency range ..... 2Hz to 17Hz

Tremolo modulation depth ..... from 0% up to 80% modulation

Average output level change for 0-50% modulation ..... -0.4dB at 50% modulation

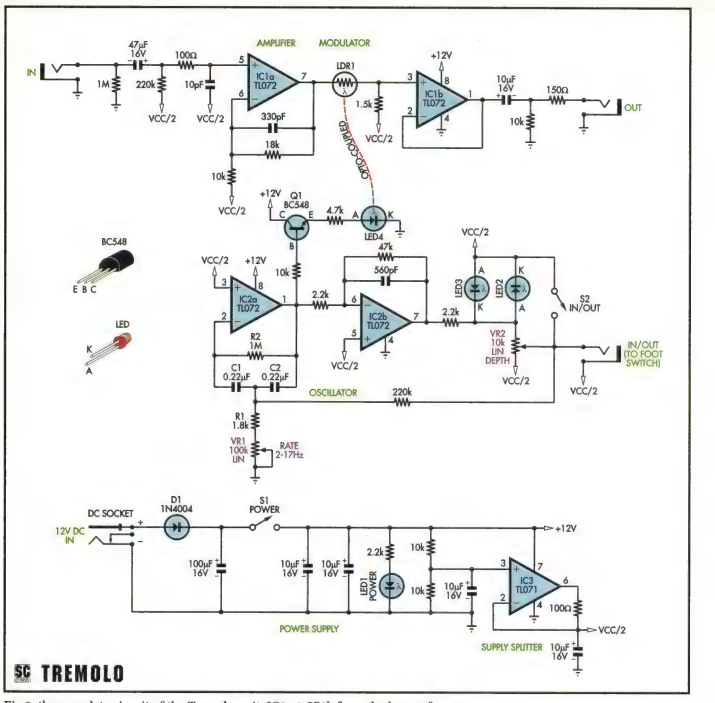


Fig.2: the complete circuit of the Tremolo unit. IC2a & IC2b form the heart of a sinewave oscillator and this drives LED4 via buffer transistor Q1. LED4 in turn is optocoupled to LDR1 and modulates its resistance to vary the signal gain.

Op amp IC1a, LDR1 and IC1b make up the signal path. As shown, the input signal comes in via a 47µF capacitor and a 100Ω resistor and is applied to the pin 5 (non-inverting) input of IC1a.

The 47µF capacitor is needed to provide AC coupling because IC1a is biased at half supply (6V), as are all the other op amps in the circuit. It is also much larger than necessary to ensure that IC1a sees a very low source impedance, to minimise noise.

The 100Ω resistor and 10pF capacitor on pin 5 are there to filter out any radio frequency (RF) signals at the op amp input.

IC1a operates with a gain of 2.8, as set by the 18kΩ feedback resistor between pins 6 & 7 and the 10kΩ resistor connected between pin 6 and the half-supply rail. This gain compensates for any signal losses in the following LDR1 and 1.5kΩ attenuator circuit.

When the tremolo modulation signal is off, LDR1 receives a constant amount of light from LED4 and has a resistance of about 2.7kΩ. As a result, the signal is attenuated by a factor of 2.8 before being applied to unity gain buffer stage IC1b. IC1b then drives the output socket via a 10µF coupling capacitor.

Note the 150Ω resistor in series with the output. This isolates IC1b from any capacitive loads which may be connected to the output socket and prevents oscillation.

Another two op amps are used in

the control circuit, with IC2a providing the high-Q filter section. This op amp has a "T-filter" circuit connected into its negative feedback loop (between pins 1 & 2). The filter components include resistors R1 & R2, capacitors C1 & C2 and the Rate pot (VR1).

The frequency of the filter is set by the value of VR1 according to the following formula:

$$f = 1/2\pi C1\sqrt{((R1 + VR1) \times R2)}.$$

Substituting the relevant values into this formula gives a frequency range of 2Hz to 17Hz (VR1 = 0-100kΩ).

The output signal from IC2a appears at pin 1 and drives transistor Q1 via a 10kΩ base resistor. Q1 in turn drives LED4, which is optocoupled to LDR1.

IC2a's output also drives inverting op amp stage IC2b, which operates with a gain of about 21 (ie, 47kΩ/2.2kΩ). Its output signal appears on pin 7 and the level is clamped at about 1.8V above and below 6V (ie, half supply) using LEDs 2 & 3.

This gives a square wave signal which swings between 4.2V and 7.8V (ie, 3.6V p-p). This signal is applied to Depth pot VR2 and the signal on its wiper then applied back to the T-filter stage via a 220kΩ resistor. It is this positive feedback that makes the circuit oscillate.

As mentioned before, the amplitude of the sinewave signal from IC2a is set by the Depth pot (VR2). This sinewave signal swings above and below the 6V level (ie, 1/2Vcc). As the signal voltage from IC2a rises, it drives LED4 harder and so its light output increases. This reduces the resistance of LDR1 and so the audio signal output level increases.

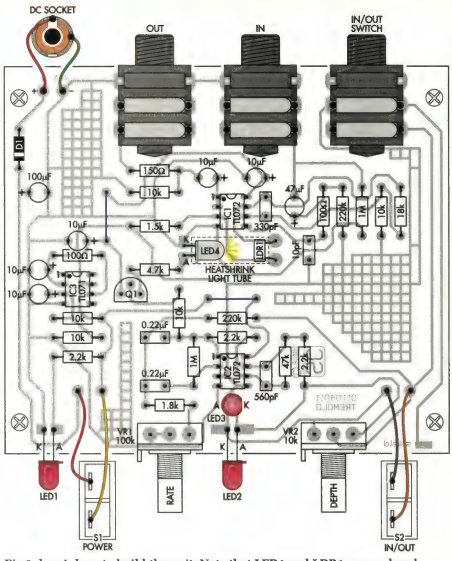
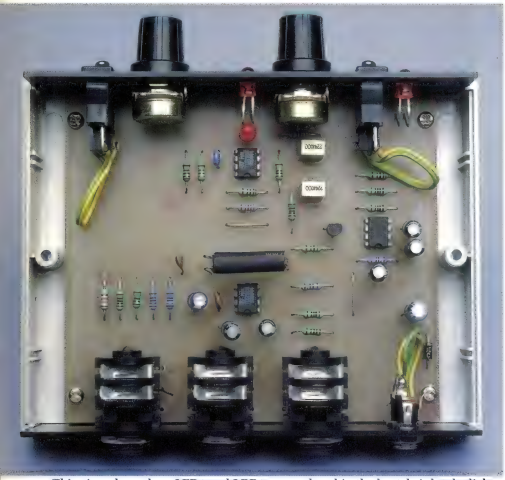


Fig.3: here's how to build the unit. Note that LED4 and LDR1 are enclosed in a light tunnel made from heatshrink tubing – see photo. Take care with component orientation during the board assembly.

Conversely, as the signal swings down, the resistance of LDR1 increases and the audio output level is attenuated. As a result, the audio output level varies continuously. VR1 sets the Rate at which the audio output level varies, while VR2 set the Depth (or range) of the level variation.

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
2	1MΩ	brown black green brown	brown black black yellow brown
2	220kΩ	red red yellow brown	red red black orange brown
1	47kΩ	yellow violet orange brown	yellow violet black red brown
1	18kΩ	brown grey orange brown	brown grey black red brown
5	10kΩ	brown black orange brown	brown black black red brown
1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
3	2.2kΩ	red red red brown	red red black brown brown
1	1.8kΩ	brown grey red brown	brown grey black brown brown
1	1.5kΩ	brown green red brown	brown green black brown brown
1	150Ω	brown green brown brown	brown green black black brown
1	100Ω	brown black brown brown	brown black black black brown



This view shows how LED4 and LDR1 are enclosed in the heatshrink tube light tunnel. Don't shrink the tubing down too far – it should be shrunk down just enough to firmly grip the two components.

When S2 is switched to the "Out" position (ie, tremolo off), VR2's wiper is held at Vcc/2 and so there is no positive feedback signal. As a result, the circuit stops oscillating and IC2a's output sits at a constant 6V. This drives LED 4 (via Q1) with a constant amount of current and so the resistance of LDR1 (and thus the audio output level) remains constant.

Because LEDs 2 & 3 are wired as voltage clamps, they flash on and off whenever the circuit is oscillating. We have put this to good use by having LED2 protrude through the front panel of the case, to give a visual indication of the oscillator rate.

Of course, once you get above about 10Hz, the LED will appear flicker quite rapidly. Note that the LED will be off when the Depth control is set to minimum and the oscillator stops, or when switch S2 is closed.

Power supply

Power for the circuit is derived from a 12VDC plugpack. This is applied via reverse polarity protection diode D1 and filtered using 100µF and 10µF electrolytic capacitors. S1 is the on/off switch, while LED1 provides power on indication.

Op amp stage IC3 is used to provide a 6V (Vcc/2) supply rail with a low source impedance. This op amp is wired as a voltage follower and has its pin 3 input biased to Vcc/2 (6V) by two 10kΩ resistors. A 10µF capacitor

Table 2: Capacitor Codes

Value	IEC Code	EIA Code
0.22µF	224	220n
560pF	561	560p
330pF	331	330p
10pF	10	10p

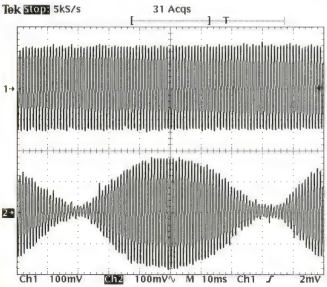


Fig.4: the top trace shows the audio input signal to the Tremolo unit while the lower trace is the modulated output signal that produces the tremolo effect.

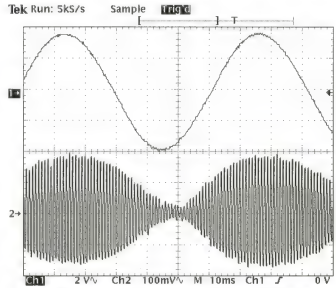


Fig.5: the top trace in this scope shot is the sinewave output at pin1 of IC2a. Notice how the lower waveform (ie, the output signal) follows the sinewave shape.

The PC board fits neatly into a compact low-profile instrument case. You can switch the tremolo effect in or out using either the front-panel switch or an external foot-operated switch

decouples this bias voltage to minimise noise.

In operation, IC3 adjusts its output at pin 6 so that pin 2 is kept at the same voltage as pin 3 (ie, Vcc/2, or 6V). The 100Ω resistor provides short-circuit protection for IC3, while the 10µF capacitor at pin 2 prevents the IC from oscillating.

Construction

Building it is easy since virtually all the parts are installed on a PC board coded 01104011 (117 x 102mm). This is housed in an ABS instrument case measuring just 140 x 110 x 35mm, to make a really compact unit.

As usual, check your etched PC board against the published pattern to ensure there are no defects (eg, shorts between tracks or breaks in the copper pattern). You should also check the hole sizes – the pots and jack sockets require 1.5mm holes, while the four corner mounting holes should be drilled to 3mm.

Fig.3 shows what you have to do to build the unit. Begin the board assembly by installing the resistors and wire links. Table 1 shows the resistor colour codes but we suggest that you check the values using a digital multimeter as well – just to make sure.

The three ICs, diode D1 and transistor Q1 can all go in next, making sure that IC3 is the TL071. Take care to ensure that these parts are correctly orientated. This done, you can install all the capacitors but again watch the polarity of the electrolytic types. Table 2 shows the codes for the low-value capacitors.

The two potentiometers can now be installed (don't mix them up), followed by the jack sockets the LEDs and the LDR. LEDs 1 & 2 should be

Parts List

1 PC board, code 01104011, 117 x 102mm
1 front panel artwork, 130 x 29mm
1 rear panel artwork, 130 x 29mm
1 ABS instrument case, 140 x 110 x 35mm
3 6.35mm mono PC-mount jack sockets
1 2.5mm DC power socket
2 mini SP rocker switches (S1,S2)
1 100kΩ 16mm linear pot (VR1)
1 10kΩ 16mm linear pot (VR2)
2 16mm diameter knobs
1 LDR (LDR1) (Jaycar RD-3480 or equiv.)
4 M3 x 6mm screws
1 20mm length of 6mm black heatshrink tubing
1 60mm length of 0.8mm tinned copper wire
1 100mm length of twin light-duty hookup wire
6 PC stakes

Semiconductors
2 TL072, LF353 dual op amps (IC1,IC2)
1 TL071, LF351 op amp (IC3)
1 BC548 NPN transistor (Q1)
3 5mm red LEDs (LED1-LED3)
1 3000mcd red LED (LED4)
1 1N4004 1A diode (D1)

Capacitors
1 100µF 16VW PC electrolytic
1 47µF 16VW PC electrolytic
5 10µF 16VW PC electrolytic
2 0.22µF MKT polyester
1 560pF ceramic
1 330pF ceramic
1 10pF ceramic

Resistors (0.25W 1%)

2 1MΩ	3 2.2kΩ
2 220kΩ	1 1.8kΩ
1 47kΩ	1 1.5kΩ
1 18kΩ	1 150Ω
5 10kΩ	2 100Ω
1 4.7kΩ	

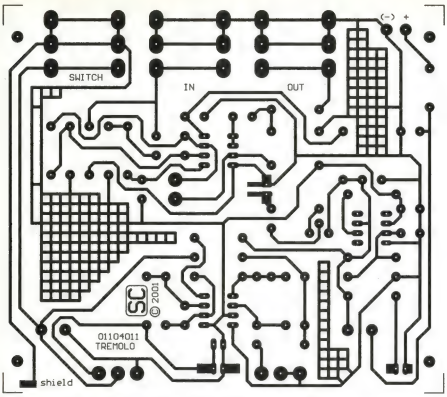


Fig.6: this is the full-size etching pattern for the PC board.

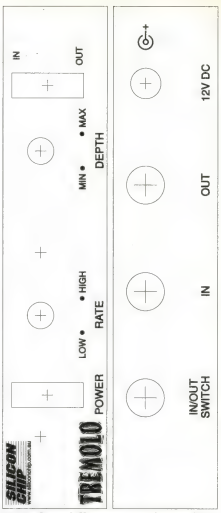


Fig.7: these full-size artworks can be used as drilling templates for the front and rear panels.

mounted at full lead length, so that they can later be bent over and pushed into their respective holes on the front panel. LED3 should be mounted about 5mm clear of the PC board, while LED4 and LDR1 should both be about 12mm clear of the board. **Important: LED4 is the high-brightness LED.**

Once these parts are in, LED4 and LDR1 should be bent over at right angles so that they face each other. These two devices are then pushed into a light tunnel made from 6mm-dia. heatshrink tubing (about 20mm long), so that only the LED light falls on the LDR – see photo.

Shrink the tubing slightly using a hot-air gun, so that the devices are properly sealed.

Finally, complete the board assembly by installing PC stakes at the external wiring points. There are six stakes in all – two each for switches S1 & S2 and two for the DC socket.

Final assembly

The next step is to drill the necessary holes in the front and rear panels, to accept the various hardware items. You can use the full-size artworks published with this article as templates to do this job. For the larger holes, it's best to drill a small pilot holes first and then carefully enlarge them using a tapered reamer.

The switch mounting holes can be made by drilling a series of small holes around the inside perimeter and then knocking out the centre piece and filing to a smooth finish.

Once you've drilled the holes, attach the front and rear panel labels, then clip the switches into the front panel and secure the two pots. You will need to fit two nuts to each of the bushes on the pots – one on either side of the panel. LEDs 1 & 2 on the PC board can then be bent over through 90° and pushed into their front panel holes.

The PC board mounts on four integral pillars on the base of the case and is secured using self-tapping M3 screws. Note that it will be necessary to first remove the unused pillars on the base using a pair of side cutters, to prevent them fouling the PC board.

Finally, complete the assembly by wiring up the switches and the DC socket, as shown on Fig.3.

The smoke test

Well, there won't really be any smoke – or at least, we hope not!

To test the unit, apply power, switch on and check that there is 12V between pins 8 & 4 of both IC1 and IC2. Similarly, there should be 12V between pins 7 & 4 of IC3, while pin 2 of IC3 should be at about 6V.

Take care not to short out any of the IC pins while making these checks. In fact, it's generally best not to probe the IC pins directly. Instead, you can connect the negative lead of your DMM to an earth point (eg, at the DC socket) and connect the positive lead to points on the circuit that directly connect to the relevant IC pins.

Now check that LEDs 2 and 3 light alternately at an increasing rate as the Rate pot is wound up. Note that the Depth pot must also be turned up for these to operate, while S2 must be switched to the "In" position.

Finally, you can check that the unit operates normally by connecting it to an amplifier and feeding in an input signal. The Tremolo effect should become quite prominent as the Depth control is wound up and you should be able to vary the rate from about 2Hz to 17Hz using the Rate control. **SC**

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The FM MiniMitter runs from a 4V supply and can drive a 300Ω dipole antenna for improved range.

By JOHN CLARKE

Build the MINIMITTER

A miniature FM stereo transmitter

Want to listen to your own selection of music through your personal stereo FM radio. Using the FM MiniMitter, you can broadcast from your CD player or from any other source so that it can be picked up within a 35-metre radius.

There are many applications for an FM transmitter, particularly if it can broadcast in stereo. You can broadcast stereo signals from your CD player or any other source (stereo or mono) to an FM tuner or radio.

The FM MiniMitter uses a single IC and a few other components and fits in a small plastic case. It broadcasts on the FM band (ie, 88-108MHz) so that it can be received by any standard FM tuner or portable radio.

We published our first version of the MiniMitter in October 1988 and it has been a very popular project ever since. So why are we presenting it again? The main reasons are to extend its transmission range (a frequent request over the years), to make it easier to tune and to make it easier to operate the input level controls.

Our new version of the FM MiniMitter operates from 3V rather than 1.5V and this can come from two AA cells or you can run it from a 6V DC plugpack. Running from two AA cells gives more than double the battery life of one cell since the circuit will continue to operate even when the supply voltage drops below 1V (although the power output and range will be much reduced).

The RCA input sockets and DC socket are all PC-mounted so there is

Main Features

- **Frequency range:** 95-105MHz (can be extended with component changes; see text)
- **Transmission range:** 40m with folded dipole antenna transmitter to typical FM receiver
- **Current consumption:** 10mA
- **Distortion:** typically 3% at 200mV audio signal level
- **Separation between channels:** typically 45dB at 1kHz

virtually no wiring to do.

Setting the input levels is now much easier and the adjustable coils have been spaced further apart to minimise interaction and allow easier tuning. However, the biggest change is in the antenna circuit. You can now use a simple wire antenna or a 300Ω dipole antenna for extended range.

Both antennas are matched correctly to the transmitter IC. The simple wire antenna is matched with a trimming capacitor while the 300Ω dipole is matched using a trimmer capacitor and a 75Ω-to-300Ω balun. These antenna improvements along with the 3V power supply provide the FM MiniMitter with a much greater transmission range. This is important, whether you are using it outdoors or between different levels in your home.

Circuit details

The FM MiniMitter is based on a BA1404 IC made by the Rohm Corporation in Japan. It incorporates all the processing circuitry required for stereo transmission which in itself is quite a complex procedure. See the separate section devoted to how an FM stereo transmitter works. Fig.1 shows the complete circuit.

Left and right audio signals are connected via 10kΩ series resistors to trimpots VR1 & VR2. The 4.7μF capacitor at the wiper of each trimpot AC-couples

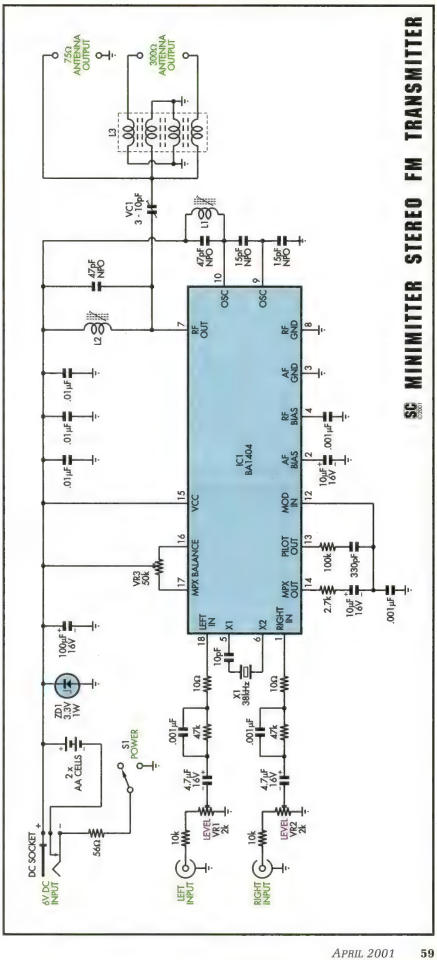
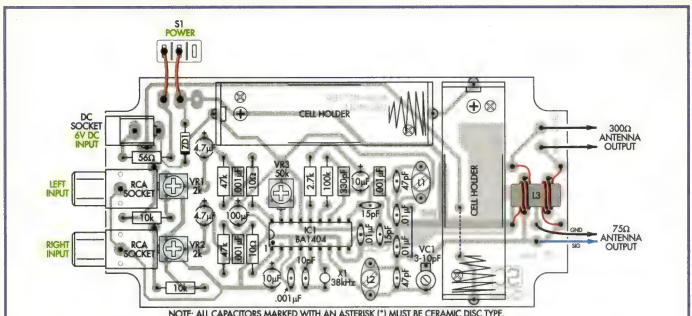


Fig.1 (right): the circuit is based on the BA1404 FM transmitter IC. It is very similar to our original circuit published in October 1988 but now uses a 3V supply and can drive a 300Ω dipole antenna for increased range.



NOTE: ALL CAPACITORS MARKED WITH AN ASTERISK (*) MUST BE CERAMIC DISC TYPE.

Fig.2: the component overlay for the PC board. The corners of the PC board must be shaped to fit around the pillars of the plastic case.

the signal to the following 50µs pre-emphasis network comprising a .001µF capacitor and parallel 47kΩ resistor.

The 50µs pre-emphasis is a defined amount of treble boost applied above 3kHz before the signal is processed in the transmitter. When the signal is received and demodulated, the boosted treble signal is subsequently attenuated so that the frequency response is flat over the audio spectrum. This process of pre-emphasis before transmission and de-emphasis at reception provides an improvement in the signal-to-noise ratio and a reduction in audible hiss.

The 10Ω resistor following the pre-emphasis components at pins 1 & 18 is there to help prevent RF signals entering the IC.

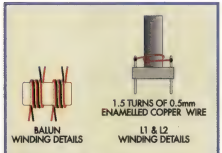


Fig.3 light duty hookup wire is used to wind the balun and 0.5mm enamelled copper wire for coils L1 & L2.

An internal bias voltage for the audio section within IC1 is decoupled by the 10µF capacitor at pin 2 and this voltage is also present at pins 1 & 18.

An internal 38kHz oscillator is formed using crystal X1 connected in series with the 10pF capacitor to pins 5 & 6. The oscillator drives the internal stereo multiplexer which switches between the left and right signals (at 38kHz). VR3 (between pins 16 & 17) provides the balance adjustment between the left and right channels.

The multiplexer output at pin 14 and the 19kHz pilot tone at pin 13 are mixed at pin 12 to produce the modulation input. The resistors and capacitors at pins 13, 14 and 12 set the correct pilot tone level which is required for detection in the stereo decoder in an FM receiver.

Following the modulator input is the RF section which includes the local oscillator and tuned output. The .001µF capacitor at pin 4 provides bypass of the bias voltages used for the RF circuitry.

The RF mixer oscillator comprises L1, the 47pF parallel capacitor and the two 15pF capacitors at pins 9 & 10. Inductor L2 and the parallel 47pF capacitor filter the oscillator output to limit transmission beyond the frequency range required for stereo transmission.

Finally, the RF output at pin 7 is coupled to the antenna and balun via a variable capacitor VC1. This is adjusted for best matching into the antenna. Balun L3 provides for a dipole antenna if required.

As already noted, the circuit is powered from 3V, either from the two onboard AA cells or from an external 6V DC plugpack. This is connected via a DC socket with internal switching. When the plugpack is connected, the internal switch disconnects the AA cells and the positive DC line is fed to the cathode (ie, positive terminal) of ZD1, a 3.3V zener diode.

The negative return line to the plugpack goes via the on/off switch and a 56Ω resistor for current limiting.

Construction

All the components of the FM Mini-Mitter are mounted on a PC board coded 06104011 and measuring 153 x 60mm. This is housed in a plastic utility case measuring 67 x 130 x 44mm. The component layout is shown in Fig.2.

You can begin construction by checking that the PC board fits neatly into the case. The corners may need to be shaped to fit around the corner pillars in the box. Check that the holes for the DC socket and RCA sockets are the correct size. Also the mounting of coils L1 and L2 may differ slightly, depending on the type of coil former used.

The PC board inside the FM MiniMitter accommodates all the components and even the input and DC sockets. The only wiring is to the 300Ω antenna terminals and to the on/off switch. Note the small ceramic capacitors with the black dot at the top; these are NPO types, specified for minimum frequency drift, and must be used for the 15pF and 47pF values.

Some coil formers require a single central hole for mounting while others mount via two PC stakes which are part of the former. The central hole former will need a hole drilled for it and the former can later be held in with some super glue. PC stakes can be inserted into the adjacent holes for connecting the wires.

Start the assembly by installing the

Table 2: Capacitor Codes

Value	IEC Code	EIA Code
.01µF	10n	103
.001µF	1n	102
330pF	330p	331
47pF	47p	47
15pF	15p	15
10pF	10p	10

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	100kΩ	brown black yellow brown	brown black black orange brown
2	47kΩ	yellow violet orange brown	yellow violet black red brown
2	10kΩ	brown black orange brown	brown black black red brown
1	2.7kΩ	red violet red brown	red violet black brown brown
1	56Ω	green blue black brown	green blue black gold brown
2	10Ω	brown black black brown	brown black black gold brown

How an FM Stereo Transmitter Works

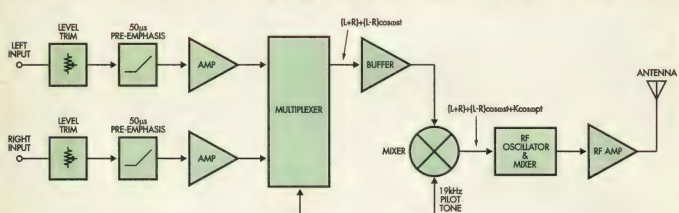


Fig.5: the block diagram of an FM stereo transmitter. The multiplexer switches the modulation input to the mixer oscillator between the left and right channels at a rate of 38kHz. The 19kHz pilot signal (ie, half 38kHz) is used to lock the 38kHz multiplex decoder (demultiplexer) in a stereo tuner.

Fig.5 shows the block diagram of the BA1404 stereo transmitter IC. The left and right channel inputs are applied to trimpots and then to a 50µs pre-emphasis circuit which provides treble boost above 3.38kHz. 50µs pre-emphasis is the Australian standard for FM broadcast. (75µs pre-emphasis is used in the USA and other countries).

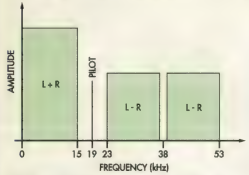


Fig.6: the frequency spectrum of the composite transmitted stereo signal. Note the spike of the pilot tone at 19kHz.

After pre-emphasis, the left and right channel signals are fed to buffer amplifiers and then to the multiplexer which is driven at 38kHz. This produces sum (L+R) and difference (L-R) signals which are modulated on the 38kHz carrier. The carrier is suppressed (removed) to provide a double sideband suppressed carrier signal.

The (L+R) and (L-R) signals are mixed with the 19kHz pilot signal which is derived by dividing down the 38kHz oscillator by two. The resulting composite signal is then frequency modulated onto a carrier frequency in the FM band. Once filtered and amplified in the RF amplifier, the signal is transmitted via the antenna.

Fig.6 shows the spectrum of the composite stereo signal. The (L+R) signal occupies the frequency range between 0 and 15kHz. The double sideband suppressed carrier signal (L-R) has a lower sideband which extends from 23-28kHz and an upper sideband from 38-53kHz. There is no subcarrier at 38kHz.

The pilot tone at 19kHz is also shown. The pilot tone is used in the receiver to reconstitute the 38kHz subcarrier so that the stereo signal can be decoded.

wire links and resistors. You can used Table 1 as a guide to the resistor colour codes or use a digital multimeter to check the values. PC stakes are inserted for switch S1 and the 300Ω and 75Ω antenna outlets.

Next, install the BA1404 IC, taking care to insert it with the correct orientation. This done, install the trimpots, trimmer VC1, the PC-mount RCA sockets and the DC socket. Zener diode ZD1 can be then be installed, followed by the capacitors. The electrolytic types must be inserted with the shown polarity, while ceramic types must be used where specified.

Make sure you use a 38kHz crystal for X1. If you are mistakenly supplied with a 32kHz watch crystal, the transmitter will not work in stereo.

Winding the coils

Coils L1 and L2 are wound as shown in Fig.3. Wind one and a half turns around each former, using 0.5mm enamelled copper wire. The coil winding should be made within the lower half of the former. Insert each former into the PC board and solder the wires in position.

The ferrite slugs can then be inserted and screwed in so the top of each slug is about flush with the top of the former. Use a plastic or brass alignment tool to screw in the slugs. Using an ordinary screwdriver is bad for two reasons: (1) it is very easy to crack the slug; and (2) the screwdriver badly affects the tuning of the coils.

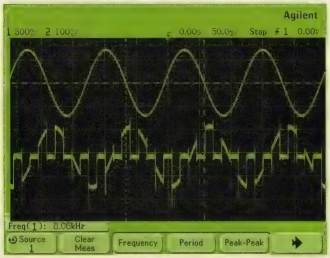


Fig.7: these scope waveforms show the 38kHz multiplex output waveform at pin 14 of IC1 when an 8kHz sine-wave is fed into the left channel.

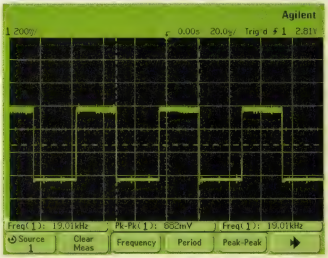


Fig.8: the 19kHz pilot tone at pin 13 of IC1 is a square wave.

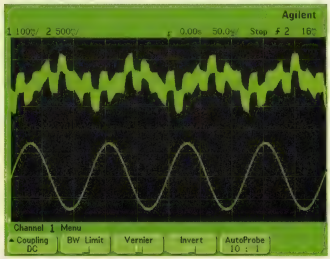


Fig.9: the final modulation waveform appearing at pin 12 of IC1 combines the left and right inputs (in this case, only the left 8kHz input), the 19kHz pilot and the 38kHz switching.

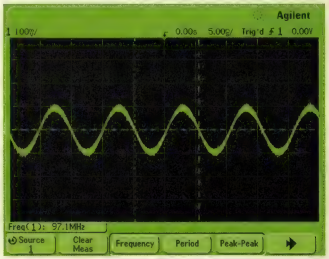


Fig.10: if you have a 100MHz scope you can measure the RF output at the input to the balun. Use a 10:1 probe.

The balun is wound using red and black light duty hookup wire, also as shown in Fig.3. The colours make it easy to identify each winding when you connect it to the PC board. Each wire is looped twice through the ferrite balun core, as shown in Fig.3. The finished balun is connected to the PC board stakes, taking care to connect the correct wire to each PC stake.

The two AA cell holders are each wired to the PC board, taking care to orient each holder correctly. The holders can be held in place with small screws and nuts or simply glued in place using a hot glue gun, silicone sealant or even contact adhesive.

The case requires holes for the RCA sockets and the DC socket. The screw terminals for the 300Ω ribbon cable antenna connections are mounted at the other end of the case. The screw terminal plate is secured with two screws which tap into the plastic case. Drill holes for the connection screws to pass through into the case and holes for the internal connection tabs. These are bent flat inside the case to allow the PC board to be easily installed without fouling.

You will also need a hole in the lid for the power switch. Wire up the switch and the 300Ω terminals using light-duty insulated hookup wire.

Testing

Testing the transmitter can be done using two AA cells or with a 6VDC plugpack. Apply power and first check

You can connect either a 300Ω dipole antenna to the screw terminals or run a length of wire from the 75Ω signal output on the PC board out through the adjacent hole.

The two RCA connectors and DC socket mate with holes drilled in the other end of the case (ie, opposite the antenna terminals).

for a nominal 3V between pins 3 and 15 of IC1. Now connect the 300Ω dipole antenna to the connecting screws or use a 1.5m length of insulated hookup wire connected to the 75Ω signal terminal on the PC board. Do not use both antennas together.

You will need a stereo FM tuner or radio to tune the transmitter. The FM tuner and transmitter should initially be placed about two metres apart. Do not connect a program source to the FM MiniMitter at this stage.

Begin by setting the FM tuner to around 100MHz, where there is no other station. The tuner should produce a lot of noise, indicating that there is no station present.

Now adjust the slug in L1 using a suitable trimming tool, until the transmitter is tuned in; this will cause the noise level from the tuner to drop right down. This is called "Quieting" by the way.

This done, adjust the slug in L2 so that the stereo indicator light on the FM tuner comes on (if there is one); background noise should be minimal.

You can now connect up a stereo signal source such as a CD player to the inputs and check if you receive this in the tuner.

If all is OK, carefully adjust trimpots VR1 and VR2 for best sound from the tuner; there should be no noticeable distortion and sufficient signal to be above any background noise. Set VR3 so that the left and right channels are correctly balanced (ie, equal in loudness).

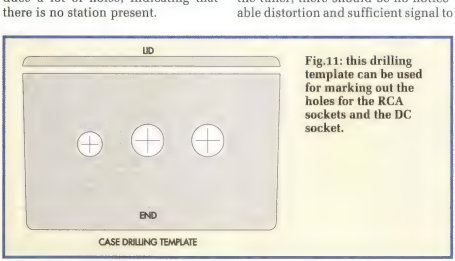


Fig.11: this drilling template can be used for marking out the holes for the RCA sockets and the DC socket.

Adjusting VC1 for best range

The variable capacitor, VC1, feeding the antenna will need to be adjusted for best transmission range. Connect the antenna you intend using to the transmitter and disconnect the receiver's antenna (or move it as far away as practical). Adjust trimmer VC1 for best signal strength in the receiver. If you cannot remove the antenna on the receiver, it will be necessary to place it about 20 metres or more from the transmitter and then adjust VC1 for best reception, as best you can.

The ultimate range for the MiniMitter depends on the orientation of the 300Ω antenna, its height and the sensitivity of the receiver. The 300Ω dipole antenna transmits its signal with maximum strength broadside to the dipole. Similarly, the FM receiver has best pickup broadside to its antenna. When using a single length of wire as a 75Ω antenna, best range will be obtained when both antenna and receiver have the same orientation; ie, both vertical or both horizontal.

Note that the FM MiniMitter will

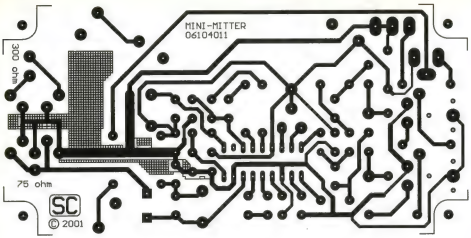


Fig.12: this is the actual size artwork for the PC board. It's a good idea to check your etched board against this pattern before installing any of the parts.

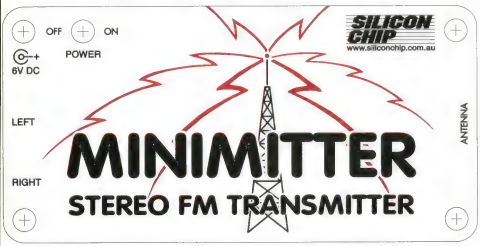


Fig.13: the front panel artwork. It too can be used as a drilling template.

not quite cover the full FM band with the range of adjustment provided by the slug in coil L1. To cover the range between 105MHz and 108MHz, you will need to change the 47pF capacitors across L1 and L2 to 39pF. Alternatively, to cover the range below 95MHz down to 88MHz, change the 47pF capacitors to 56pF.

Again, these capacitors must be NPO ceramic types (ie, zero temperature coefficient) to minimise frequency drift in the transmitter.

If the FM MiniMitter will only be used with batteries, you can remove the DC socket and zener diode ZD1 and use a wire link in place of the 56Ω resistor. This will marginally improve cell life by preventing current flow through the zener and also remove the slight voltage drop across the 56Ω resistor.

Connecting a mono source

Even though the FM MiniMitter is specifically designed for stereo transmission, you may want to use it with a mono source. What do you have to do?

If you want reception in both channels on a stereo tuner or radio, you must connect the mono signal to the left and right channel inputs. The simplest way to do this is to use a mono to stereo bridging lead which will have three RCA connectors (one for the input and two for the outputs). You can make this up yourself or purchase it as an accessory from kitset suppliers (eg, Jaycar Cat WA-7054) or from hifi stores.

Of course, if you have a stereo tuner which can be switched to mono mode, the above course will not be necessary. In this case, you can simply connect the mono source to the left or right channel input on the MiniMitter.

Note that operating in mono will also give a slightly better signal-to-noise ratio. **SC**

Parts List

1 PC board, code 06104011, 153 x 60mm
1 plastic case, 67 x 130 x 44mm
1 front panel label, 127 x 64mm
1 PC-mount DC socket
1 stereo PC-mount RCA sockets or two insulated RCA sockets
1 SPDT toggle switch (S1)
1 2-way screw loudspeaker terminal panel
2 AA cell holders
2 ferrite slug coil formers (L1,L2)
2 F29 ferrite screw slugs
1 6mm balun core
1 38kHz crystal (X1)
2 M3 x 6mm screws
7 PC stakes
1 60mm length of 0.5mm enamel copper wire
1 100mm length of red light gauge hookup wire
1 100mm length of black light gauge hookup wire
1 100mm length of medium duty hookup wire
1 90mm length of 0.8mm tinned copper wire

Semiconductors

1 BA1404 stereo FM transmitter IC (IC1)
1 3.3V 1W zener diode (ZD1)

Capacitors

1 100μF 16VW PC electrolytic
2 10μF 16VW PC electrolytic
2 4.7μF 16VW PC electrolytic
3 .01μF ceramic
3 .001μF MKT polyester
1 .001μF ceramic
1 330pF ceramic
2 47pF NPO ceramic (see text)
2 15pF NPO ceramic
1 10pF ceramic
1 3-10pF trimmer capacitor (VC1)

Trimpots

2 2kΩ horizontal trimpots (code 202) (VR1,VR2)
1 50kΩ horizontal trimpot (code 503) (VR3)

Resistors (0.25W, 1%)

1 100kΩ	1 2.7kΩ
2 47kΩ	1 56Ω
2 10kΩ	2 10Ω

This "intelligent" Nicad battery charger was designed for high-current, rapid-charge applications, such as cordless power tools and model racing cars. It's just the shot for recharging battery packs ranging from 7.2V to 14.4V.

By PETER HAYLES

Intelligent Nicad Battery Charger for Power Tools

AS A KEEN HANDYMAN, I have a number of power tools, including a few cordless types that run off nicad battery packs. These battery packs range from 7.2V to 14.4V and almost inevitably contain Sanyo or Panasonic nicad cells, regardless of the brand of the tool itself.

Properly treated, these battery packs should be good for hundreds of charges and can potentially last many years. Unfortunately, proper nicad chargers are usually expensive and the cheap chargers supplied with the original equipment often incorrectly charges the cells and dramatically shortens their life.

Recently, I found that my 2-year-old 9.6V cordless drill battery wouldn't perform to its rated capacity after charging. Unfortunately, battery packs are fairly expensive to replace, sometimes costing almost as much as the entire drill kit – and that's if you can purchase the battery pack separately at all. Often, you will simply be told to just "buy a new drill".

In fact, it is far cheaper to purchase your own cells and manufacture a "new" battery pack using the old case. This involves soldering leads between the battery tags to connect them in series. Note, however, that you should never solder directly to the cell cases – that can damage them and is quite dangerous.

In selecting replacement cells, I researched the manufacturer's specifications on charging and guess what? – the battery charger that came with the drill didn't comply with these specifications. Instead, the supplied charger is a very simple device that applies a constant current to the battery pack and doesn't cut out once the pack is fully charged.

As a result, once the cells are fully charged, the battery starts to heat and the internal pressure builds up. This can lead to permanent cell damage and in serious cases, the battery can

rupture or vent electrolyte.

Having paid good money for a new battery pack, I decided to design a new charger that would not damage the battery. In particular, I wanted a charger that not only met the specifications but would also sense the condition of cells and charge accordingly.

In short, I wanted to be able to "throw" the pack on the charger and know that it would be "good" the next time I reached for it. And that meant it had to be fully automatic, with no switches to set.

Meeting these requirements also meant that the charger required some inbuilt "intelligence", so logic control circuitry was required. At the same time, I wanted to keep the design as simple as possible and keep the component count down – after all, reducing the size of a PC board and the number of holes in it leads to major cost savings.

In the end, I decided on a very simple 1-chip design based on a PIC microcontroller (PIC is a registered trademark of MicroChip and refers to a range of microcontrollers). That way, it's the software that's programmed into the PIC that does all the hard work. If you don't have a PIC programmer, don't panic! – programmed PICs to suit this design are available inexpensively from the author.

Other than this, only a few commonly available components are required to complete this project. The "all-up" cost should be about $60 which is a lot cheaper than your next battery pack!

Nicad characteristics

Even if you don't want to build this charger, you can still learn how to get the most from your nicad batteries. To start with, a "cell" is defined as a single vessel containing electrodes and electrolyte for generating current. A battery consists of two or more cells. Nicad cells are rated at 1.2V for design purposes, although they normally develop about 1.25V and require a charging voltage of 1.5V (during full charge).

Nicad cells can supply very large amounts of current and display a remarkably flat discharge characteristic, maintaining a consistent 1.2V throughout discharge. The voltage then drops quite suddenly and a cell is almost completely flat at 0.8V. This is called the "knee" characteristic because of the shape of the graph of voltage against time.

Nicad battery capacity is rated in mAh (milliampere-hours) and is commonly referred to as "C" – ie, it can supply 1C mA for 1 hour, 2C mA for 30 minutes, etc. Three different charging techniques are commonly employed: trickle charging whereby the battery is "topped up" at 3.3% of C to 5% of C; slow charging at 10-20% of C; and fast charging at 50-100% of C.

Slow charges are not meant to be continually applied and since nicad

Below: the unit is easy to build since virtually all the parts are on the PC board. Keep the wiring neat and tidy by using cable ties and note that the large metal diecast case is necessary for heatsinking.

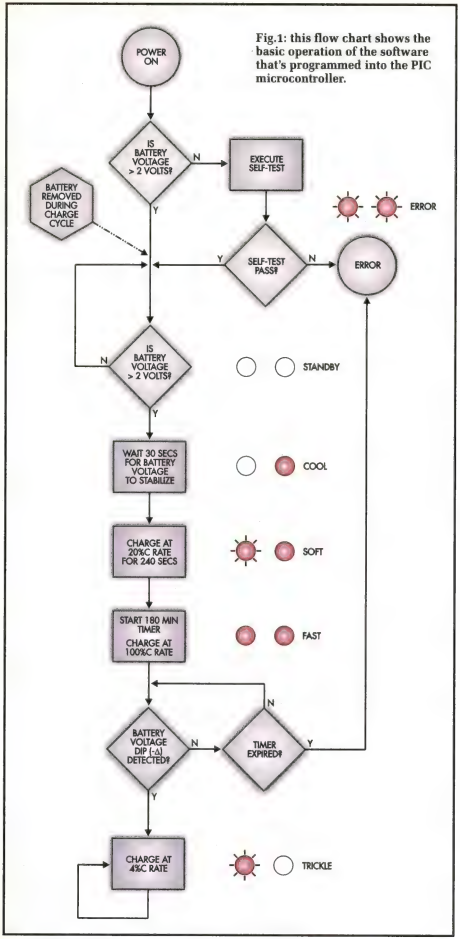


Fig.1: this flow chart shows the basic operation of the software that's programmed into the PIC microcontroller.

batteries are about 66% efficient, this type of charging normally takes about 8-15 hours. On the other hand, fast charges at 100% of C should be terminated after about 1.5 hours, assuming that the battery is flat to begin with.

Once a battery is fully charged, it produces gas and this creates a high internal pressure and a sudden rise in temperature. At this point, the battery should be switched to trickle charging, otherwise it will begin to vent and release its electrolyte. And that permanently damages the cells.

As a matter of interest, my old battery was rated at C = 1300mAh and my old charger was rated 400mA (30% of C). This means that the charger should have been switched off after about four hours, provided that the battery was almost flat to begin with.

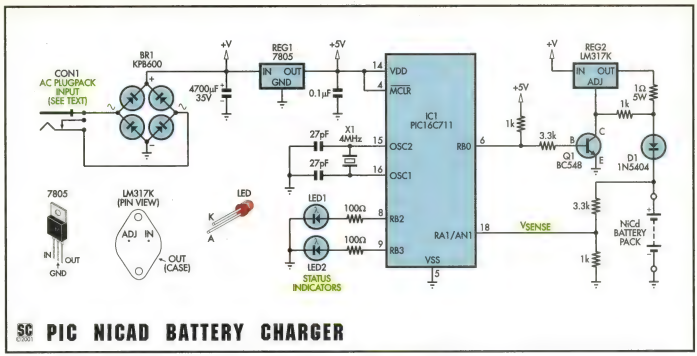
However, there is no way of knowing if C was actually 1300mAh or if it had decreased a bit. Once a battery starts to deteriorate, it becomes a vicious cycle and the battery then deteriorates rapidly due to more and more overcharging. According to the manufacturer, the cells supplied with my drill should have been good for 500-1000 cycles if properly treated!

The memory effect

Possibly the biggest misconception that surrounds Nicad cells is a result of the so-called "memory effect". Almost every one quotes it as the reason that cells have to be completely flattened (ie, to 0V) before charging – otherwise they develop some sort of memory and can only hold a partial charge from there on.

The "memory effect" was discovered during the early days of satellites. They used solar cells to charge nicad batteries and these batteries were subjected to precise charge/discharge cycles many hundreds of times, as the satellite alternated between darkness and sunlight during its orbit. However, memory effect isn't a problem if the charge/discharge cycles are varied – it certainly isn't a significant problem in normal home usage.

Although it may be OK (but not really a good idea) to discharge individual cells to 0V, this is certainly not recommended for an entire battery of cells. The reason is simple – when a battery is discharged below 0.8V per cell, one of the cells is inevitably weaker than the others and goes to 0V



SC PIC NICAD BATTERY CHARGER

Fig.2: the PIC microcontroller (IC1) is at the heart of the circuit. It continually samples the battery voltage and outputs a PWM waveform which controls constant current source REG2 via transistor Q1.

first. If the battery is further flattened, this battery becomes reverse charged (ie, it reverses polarity) and this weakens it even further. This creates an effect called "voltage depression" and it's quite common in battery packs that are treated this way.

Eventually, the battery's performance drops off quite suddenly which ironically is the very thing that the user is trying to prevent. Preventing this problem is quite straightforward – don't discharge the battery to 0V.

Most users know where the battery's "knee" occurs; it is when the tool first starts to show signs that the battery performance (and hence battery voltage) is suddenly dropping. It is a good idea to immediately recharge the battery from this point. Usually, there will be less than 5% of C remaining anyway.

One other thing – Nicad batteries don't like getting too hot or too cold. They will not take a full charge and they actually discharge (even under no load) much faster when over 40°C or below 0°C. For this reason, you should avoid leaving cordless tools inside a hot car. In addition, a nicad battery pack builds up internal heat when working, so don't over-work the tool.

Nicad batteries should also be left to cool down for a while after discharge before recharging them. Note also that Nicad batteries do self-discharge and the rate is also temperature related. As a rule of thumb, they will hold a full charge (with no load) for about a month or two but when they get old or hot, they might only last a day.

So what can you learn from this? The rules are:

(1). Don't flatten a nicad battery below 0.8V per cell.

(2). Don't overcharge your battery beyond 100% of C.

(3). Nicads don't like to get too hot or too cold (0-40°C is usually best).

Nicad charging

The nicad batteries used in cordless tools and model racing cars generally have a value of "C" ranging from 1000-3000mAh. The first step is to determine what "C" is for your cells. You can do that either by directly inspecting the cells (assuming that the battery pack can be easily disassembled) or by contacting the manufacturer for the part number. The value for "C" is often included in the part number and its specifications can be checked out on the manufacturer's website.

For my new battery, the value for "C" was 1700mAh. Note that the "C" of the individual cells is the same as the "C" of the complete battery.

When designing a charger, you should first consider how the cells are to be used. For power tool and model car applications, the charge use is termed "cycle use" because the battery is repeatedly charged and discharged. In addition, the charge time required is usually as fast as possible – ie, between 1 and 2 hours.

My batteries were capable of taking a fast charge of 100% of C, which equates to 1.7A. Despite this, I conservatively selected 1.25A as my charge current because I wanted to be able to charge 1300mAh (1.3Ah) batteries as well. This value should be OK for most readers and it doesn't really matter if it is a bit less than 100% of C, because the charger will eventually detect a peak anyway. However, some readers will want to adjust the maximum charging current and this procedure is described later on.

For "cycle use", there are two recommended methods of detecting charge termination – either using a temperature sensor in the battery pack or using a "negative delta V" cutoff system. The temperature technique relies on detecting the sudden rise in battery temperature when the battery is fully charged and using this to shut down the charger. There is nothing wrong with doing this but battery packs do not always come with temperature sensors built in. Furthermore those that do, often sense the temper-

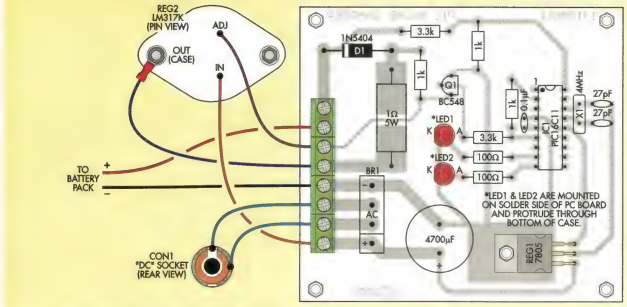


Fig.3: follow this wiring diagram to build the Intelligent Nicad Charger. Make sure that all semiconductors are correctly orientated and note that the 1Ω 5W resistor should be mounted slightly proud of the PC board, to aid cooling.

ature of one cell only.

The "negative delta V" system relies on the fact that the battery voltage peaks and then drops about 15-20mV per cell when fully charged. This charger will detect a minimum peak of about 84mV and so can be used to charge battery packs ranging from 7.2V to 14.4V (ie, 6-12 cells). Note that the upper limit is determined by the maximum output voltage of the charger.

No matter how discharged the battery is, this technique will give enough charge to restore the battery to its full state. The battery is then continually "topped up" with a trickle charge to prevent slow leakage due to its internal resistance.

Another thing to consider is the requirement to let the battery cool down before recharging. If a battery is hot, its output voltage will rise slightly as it cools. This battery charger is programmed to wait until the battery voltage is stable for about 30 seconds before starting to charge. If the battery has just come off discharge and is hot, it may take a minute or so for the charge to begin to start.

In addition, new batteries may show false peaks during the first four minutes of charging. For this reason, the charger starts with a slow "soft start" charge for four minutes, to allow the battery to cool and get past this point.

In order to make the unit fully automatic, it also automatically detects when a battery is connected for charging. There's just one proviso here – the battery voltage must be above 2V (open circuit) for the charger to recognise it. If a battery pack is discharged to 0V, it won't be recognised and the charger won't start.

In practice, this isn't a problem since a cordless tool or model car stops working altogether when the pack gets down to about half voltage (ie, 3.6V for a 7.2V pack, or 7.2V for a 14.4V pack). Of course, no-one uses a tool until it stops working altogether – instead, the battery is placed on charge as soon as there is a marked deterioration in performance.

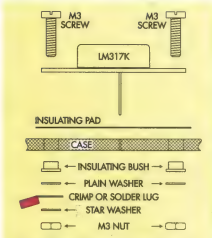


Fig.4: this diagram shows the mounting details for the LM317K regulator (REG2). Make sure that it is electrically isolated from the case.

The charging algorithm used by the PIC microcontroller is shown in Fig.1. Note that the first LED is on continually during the "bulk charge" process, while the second LED indicates the type of charge being applied.

The operation of the charger is fairly straightforward. Normally, when the charger is switched on, both LEDs flash once. The charger then waits in standby mode until a battery is connected. Once a battery is connected, the charger progresses though several modes: ie, cool, soft, fast and trickle.

At the end of the charging process, the battery can be left on trickle charge indefinitely, or removed from the charger at this point. When the battery is removed, the charger reverts to standby.

Basic operation

Fig.2 shows the full circuit details of the Nicad Battery Charger. It uses a PIC microcontroller (IC1) to generate a pulse width modulated (PWM) waveform and this signal switches a constant current supply based on REG2 which is used to charge the battery.

In operation, the PIC microcontroller senses the battery voltage and con-

verts this to a digital value using an internal A/D (analog-to-digital) converter. It then adjusts its PWM output signal to control the charging rate accordingly. It also drives the two LEDs, to indicate the charging status.

The smallest and cheapest microcontroller that could be used to perform the A/D conversion and still have the necessary functions and control lines is the PIC16C711. This device is an 8-bit, high-performance 4MHz CPU and it includes four A/D converter stages, a brown-out timer and a watchdog timer.

The timers are used to reset the chip if problems occur due to power transients or interruptions.

The PIC16C711 comes in an 18-pin dual-in-line package and has a "massive" 1K words of program memory and 68 bytes of data. It's hardly enough to load Windows 2000 but it's quite enough for a relatively simple control program.

Circuit details

OK, let's look at how the circuit works in greater detail. As shown, the circuit runs off an AC plugpack and its output is fed to a bridge rectifier (BR1) and a 4700µF filter capacitor. This capacitor reduces the DC ripple to about 1V under full load (1.5A).

REG1, a 7805 3-terminal regulator, produces the +5V rail for the PIC microcontroller. A 0.1µF capacitor is used to decouple this rail.

Crystal X1 and its associated 27pF capacitors provide a stable and accurate 4MHz timebase for IC1. This is necessary to ensure accurate time delay functions for charging. The two LEDs (LED1 & LED2) are driven directly from pins 8 & 9 of IC1 via 100Ω current limiting resistors.

Pin 18 (RA1/AN1) is used to "sense" the battery voltage. This input samples the battery voltage via a voltage divider consisting of 3.3kΩ and 1kΩ resistors. These resistors are necessary to "divide" the battery charging voltage of about 0-21.5V down to 0-5V, which is the range of the PIC's A/D converter.

Note that the PIC uses an 8-bit A/D converter, so we have 256 (2^8) possible values. This gives us a resolution of 21.5/256 = 84mV which means that a 6-cell (7.2V) pack is the smallest pack that the charger will peak detect.

The PWM waveform from IC1 appears at pin 6 (RB0) and drives switching transistor Q1 via a 3.3kΩ resistor. Q1 in turn drives the ADJ terminal of REG2, an LM317K adjustable 3-terminal regulator.

In operation, the LM317 maintains a constant 1.25V between its OUT pin and the ADJ pin. In this circuit, a 1Ω 5W resistor is connected between these two terminals and this ensures that a constant 1.25A is applied to the battery pack.

If necessary, you can adjust this value to suit your application. All you have to do is choose the charging current that you want and use Ohm's Law (V = IR) to calculate the resistor value; ie, divide 1.25V by the current that is recommended for full charge. For example, a 0.68Ω resistor will provide a charging current of about 1.7A, while 1.2Ω will provide 1A.

The circuit works like this: when Q1 is biased on, it effectively pulls the ADJ pin of REG2 to ground and so the output of REG2 will only be at about 1.25V. However, very little current will flow in the output since D1 is reverse biased and there is a 1kΩ resistor in series between the 1Ω 5W resistor and the ADJ terminal. In fact Q1 is biased on by default, so that the unit is "fail-safe".

Conversely, when Q1 turns off due to the PWM waveform from IC1, REG2 behaves as a constant current source and it charges the battery pack via D1.

Diode D1 ensures that the battery cannot discharge back into REG2 if the power is accidentally turned off! If the power is interrupted with a fully charged pack, D1 isolates the output circuit and the nicad battery will slowly discharge through the 3.3kΩ and 1kΩ voltage divider resistors. When power is subsequently restored, the charger will detect the voltage peak again and return to trickle charge after just a few minutes.

Built-in self-test

A final feature of the software is that there is a "Built-In-Test" (BIT) on power up. This effectively tests all the components except the capacitors (ie, more than 80% of the components).

During power up, if no battery is detected (ie, less than 2V on the output), the output is turned on for one second and the voltage checked. The output is then turned off. If the voltage does not reach at least 10V when high and go below 2V when low, then an error is detected. The LEDs are

Parts List

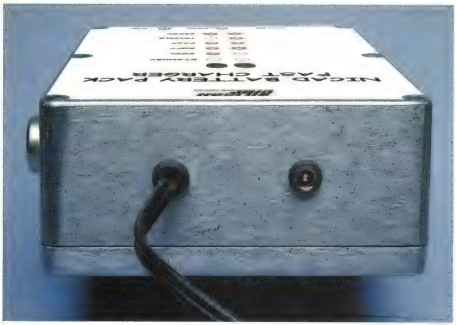
1 aluminium diecast case, 171 x 121 x 55
1 PC board, 77.5 x 85mm
1 front panel label
1 4MHz parallel cut crystal (X1)
4 2-pin PC-mount terminal blocks (4A, 0.2-inch pitch)
1 18-pin DIL IC socket
1 TO-3 insulating pad
2 TO3 insulating bushes
3 M3 x 12mm machine screws, nuts & washers
4 M4 x 12mm machine screws, nuts and washers
2 5mm LED bezels
1 5.5mm ID rubber grommet
1 2.5mm DC panel socket
1 2.5mm DC plug
1 4mm crimp lug
4 plastic cable ties
2 plastic cable tie mounts
3 300mm lengths heavy-duty multistrand cable (red)
1 180mm length heavy-duty multistrand cable (black)
1 200mm length heavy-duty multistrand cable (white)
1 600mm length heavy-duty figure-8 cable

Semiconductors
1 PIC16C711-04/P programmed microcontroller (IC1)
1 BC548 transistor (Q1)
1 7805 3-terminal regulator (REG1)
1 LM317K adjustable regulator (REG2)
1 4A or 6A 400V single in-line bridge rectifier (BR1) (DSE Cat Z3310; Jaycar Cat ZR-1360; Altronics Z0076)
1 1N5404 power diode (D1)
2 5mm red LEDs (LED1, LED2)

Capacitors
1 4700µF 35VW electrolytic (36mm high)
1 0.1µF monolithic
2 27pF ceramic

Resistors (0.25W, 1%)
2 3.3kΩ
3 1kΩ
2 100Ω
1 1Ω 5W wirewound

Miscellaneous
Thermal grease (see text), heatshrink sleeving, solder.



The connecting cable for the battery pack emerges from a grommetted hole in one end of the case. The adjacent socket is for the external AC plugpack supply.

both powered on simultaneously during this BIT. If there is an error the LEDs then flash alternately.

This mode can be verified by shorting the output on power up or plugging in a battery during the BIT. The error mode will also be invoked and the LEDs will flash if no peak is detected after three hours of main charge. The unit will then time out and switch off automatically.

Construction

All the parts except for REG2 are mounted on a PC board coded 14104011 and measuring 77.5 x 85mm. This board is mounted in a substantial metal diecast case, which is necessary to ensure adequate heatsinking for REG2.

Fig.3 shows how the parts layout on the PC board. The board is easy to assemble but take care with the orientation of Q1, IC1, D1 and the 4700µF electrolytic capacitor. Pin 1 of IC1 is adjacent to a small dot in the body at one end of the device.

Regulator REG1 is mounted flat against the PC board, with its leads bent at right angles to pass through the holes. It is secured to the board using an M3 screw and nut and the copper pad on the underside of the board provides all the necessary heatsinking for this device.

It's a good idea to mount the 5W resistor about 3mm proud of the board, as it gets quite warm during operation. This will allow the air to circulate beneath it for cooling.

Unlike the other parts, the two LEDs are mounted from the copper side of the PC board. The top of each LED should be about 13mm above the board, so that they pass through matching holes drilled in the base of the case when the board is mounted in position. Note: the base of the case becomes the front panel.

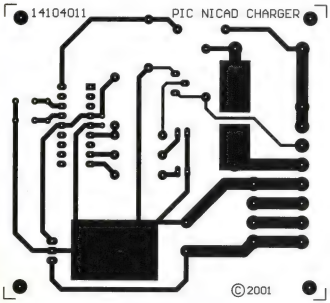


Fig.5: you can make your own PC board from this full-size etching pattern or buy a ready made board from RCS Radio.

Mounting REG2

The LM317 (REG2) is mounted on the side of the aluminium diecast case using a standard TO-3 insulating kit to ensure electrical isolation. Fig.4 shows the mounting details.

Use the insulating pad as a template to mark out the hole positions, then drill the holes and use an oversize drill to remove any metal swarf. Carefully inspect the mounting area to ensure that it is completely smooth and free of any swarf before mounting the device, as a sharp edge could "punch-through" the insulating pad and short the device to the case.

The insulating pad can be either a mica washer or a silicone impregnated washer. If you use a mica washer be sure to smear all mating surfaces with thermal grease to aid heat transfer, before bolting the assembly down. Once the regulator is in position, use your multimeter to confirm that its metal body is indeed isolated from the diecast case.

Note that the LM317 will dissipate about 12W when charging smaller batteries so don't use a smaller case than the one specified, otherwise the heatsinking will be inadequate. If even higher power dissipation is required (eg, if you are fast-charging at more than 1.25A), then REG2 should be fitted to a substantial heatsink.

Once the board assembly has been completed, it can be mounted inside the case. To do this, you will need to mark and drill out four 4mm holes for the mounting screws, plus two holes for the indicator LEDs. Another two holes are required in one end of the case to accept a small rubber grommet (8mm) and the power socket.

The PC board is mounted on 10mm standoffs and secured using four M4 x 12mm countersunk screws, nuts and

washers. Note that the screws must have countersunk heads, because they have to go under the label. The two LEDs should be pushed into matching holes in the case as the board is mounted, with their tops just flush with the case surface.

The internal wiring is shown in Fig.3 and the photo. The external lead to the battery pack is run out via the 5.5mm ID grommet and is fitted with a 2.5mm DC power plug. The AC power leads are connected to an adjacent 2.5mm panel socket (note: choose a size that suits your AC plugpack supply).

To ensure reliability, it's a good idea to secure the wiring using four cable ties. Two of these cable ties pass through cable tie mounts, as shown in the photo.

Finally, the front panel label can be affixed in position. The two LED can be dressed up by fitting plastic bezels if you wish.

Testing & operation

This unit requires a 24VAC input to charge 14.4V batteries, although only 16VAC is required to charge anything smaller. The AC power source must be rated at the chosen supply current or better – typically 1.5-2A. This can come from an external AC plugpack supply.

The bridge rectifier and 4700µF filter capacitor should produce about 1.4 times the AC RMS input. So if using a 16VAC supply, the main rail should be about 22VDC. If using 24VAC, this rail should be about 30VDC. You should also check that the 5V rail is present at the output of REG1 and that there is at least 2.5V across the LM317; the 1Ω current sensing resistor and diode D1.

For the connection to the battery, I used my existing charger pack after first removing the internal circuitry – which was no more than a transistor and LED to indicate that current was being delivered. For power connections, EIAJ DC voltage connectors and plugs are standard, with the positive usually being the centre pin.

The front panel artwork includes a legend that explains all the possible states for the LED indicators. If both LEDs are flashing, it indicates that there has been an "error". This simply means that the unit has failed to detect a peak voltage as the battery pack charged and has timed out (ie, after three hours) but this should rarely happen.

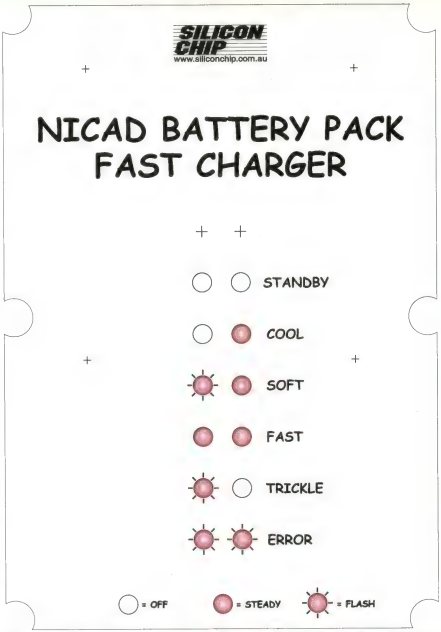


Fig.6: the front panel artwork shows the mounting points for the PC board and indicator LEDs and also indicates the LED flash codes.

Conclusion

This unit has halved the charging time for my drill battery pack, from 3-4 hours to 1.5 hours maximum. It's nice to know that I can now "throw" the battery pack on the charger and that it will be fully charged and the next time I want to use it – and that's the way it should be. **SC**

WHERE TO BUY PARTS

A programmed PIC microcontroller for this project is available from the author for $A20 plus $A5 for post and packaging (in Australia). Payment may be made by bank cheque or money order. Contact: Peter Hayles at peterhayles@hotmail.com

Note: copyright of the PIC software and PC board associated with this design is retained by the author. Individuals can make their own PC boards on a one-off basis or purchase a board from RCS Radio – phone (02) 9738 0330.

Tweaking Internet Connection Sharing

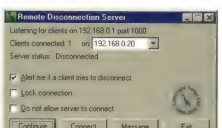
by GREG SWAIN

ICS Remote Disconnection Utility

Internet Connection Sharing (ICS) – included with Windows 98SE and Windows Me – allows a host computer to share its Internet connection with other PCs on a network. However, apart from demand dialling, it gives the clients no control over the Internet connection.

This free "Remote Disconnection Utility" (RDU) allows users on client machines to easily connect and disconnect the host from the Internet. What's more, it notifies other users of any intention to close down, so that they can prevent the disconnect.

RDU also allows users to "lock" a connection, to prevent disconnects while they are away from their machines, and includes a simple messaging utility. It is automatically launched at start-up and minimised to the System tray.



A message with a countdown timer pops up on other machines when a user makes a request to disconnect.

The latest version of rdusetup.exe (1.75Mb) is available from Twiga Limited's web site at **www.twiga.ltd.uk**

Changing The Host IP Address

By default, when ICS is installed, the host computer (the one with the modem) is assigned a fixed IP address of 192.168.0.1. But what if you want to change this because another computer on the network already has this address?

The first step is to assign a new IP address to the network card. Launch the Network applet from Control Panel, then select the TCP/IP entry for your network card and click Properties. Enter the new IP address – eg, 192.168.0.5 – and click OK, then follow the bouncing ball to restart your computer (it's a Windows tradition; why does Santa Claus wear a red suit?).

The next step is to launch the Registry Editor (Start, Run, Regedit) and drill down to **HKEY–LOCAL–MACHINE, System, Current Control Set, Services, ICS Sharing, General.** Right-click the "IntranetInfo" entry and modify the data value of the first number (before the comma) to the new IP address of the host (in this case, 192.168.0.5). Finally, go to **HKEY–LOCAL–MACHINE, System, Current Control Set, Services, ICS Sharing, Addressing, Settings** and modify the Start value to the second address in the IP range; ie, to 192.168.0.6 (the DHCP service will now hand out addresses starting from this number).

Disabling The DHCP Service

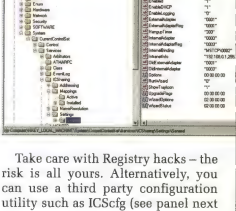
There are several reasons why you might want to turn off the DHCP service that's installed by default with ICS on the host PC, including avoiding conflicts with other DHCP servers on a network.

To do this, launch the Registry Editor (Start, Run, Regedit) and drill down to **HKEY–LOCAL–MACHINE, System, Current Control Set, Services, ICS Sharing, General** and right-click the "Enable DHCP" entry in the Data pane. Click modify from the drop down list, change the data value to 0 and click OK.

When you restart the machine, the DHCP service will be disabled.

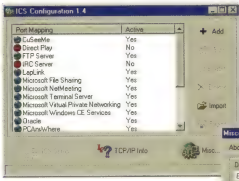
You can now give the clients static IP addresses. Give each client a unique address in the range from 192.168.0.2 to 192.168.0.254 and assign each a subnet mask of 255.255.255.0.

Finally, enable DNS on each client, and add 192.168.0.1 (ie, the IP address of the host) to the DNS Server Search Order, then click the Gateway tab and enter a default gateway of 192.168.0.1.



Take care with Registry hacks – the risk is all yours. Alternatively, you can use a third party configuration utility such as ICScfg (see panel next page).

ICS Configuration Utility For Port Mapping & Other Hacks

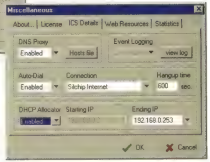


If you're not too confident about hacking the Registry, this handy ICS configuration utility could be just the shot. It's called ICScfg (written by Harley Acheson) and you can download it free of charge from **www.practicallynetworked.com** (icscfginst.exe; about 1Mb).

ICScfg can be used to add, close and otherwise manage ports in ICS. This makes it easy to close down port that are normally enabled by ICS but are not required for your application, for example. Closing down unused ports can give increased security against hackers.

ICScfg also makes it easy to enable or disable the DHCP service, enable or disable auto-dialling and adjust the hangup time (ie, the idle disconnect timer). The default value for the Hangup Timer is 300 seconds and it's usually not a bad idea to increase this to 600 seconds (10 minutes)

Note, however, that ICS defaults to disconnecting after either this time or after the "Disconnect if idle" setting in Internet Explorer, which ever is the shorter.



Other facilities include the ability to view the ICSlog.txt file and to change the range of IP addresses handed out by the DHCP service.

By the way, ICScfg does nothing that cannot be achieved by manually hacking the registry – it just makes it easier to do.

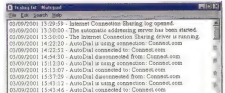
Finally, note that this utility is for Windows 98SE and Windows Me only; it doesn't work under Windows 2000.

Logging ICS sessions

Logging can be handy when it comes to troubleshooting unwanted dial-outs with ICS. The amount of information supplied is minimal but at least you can check the dial-out times.

To enable logging, fire up the Registry Editor, go to **HKEY–LOCAL–MACHINE**, **System**, **Current Control Set**, **Services**, **ICS Sharing**, **General** and change the data value for the "Enable-Logging" entry from 0 to 1.

When you reboot, ICS will write a log file to c:\windows\ICSlog.txt. This file is renamed to ICSlog.old each time you reboot. You can drag shortcuts to both these files to the desktop to make them easy to access when troubleshooting.



Making ICS Demand Dial

If ICS refuses to dial out on demand when a client attempts to initiate a session, check that the "Always dial my default connection" option is enabled in Internet Explorer on the host machine (click Tools, Internet Options, Connections).

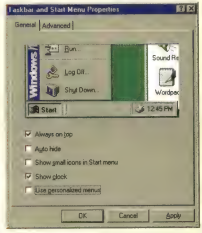
If that's OK, check the DialupEntry value for ICS in the registry. If it's "", change it to "x". Check also that the DialOnDemand value is "1" and reboot for the changes to take effect.

GENERAL TIPS

Disable the Down Arrows in Windows Me's Start Menu

Do you hate the way Windows Me hides entries in the Start menu for programs that you haven't used recently? Clicking on those double-headed down arrows to reveal them again can be a real pain.

Fortunately, this feature is easy to disable. Just right-click the Taskbar, choose Properties and uncheck the "Use personalised menu" entry – see below.



Keep Your Hard Disk Healthy

Applications that fail to close down correctly can leave temporary (.tmp) files littered on your hard disk. To free up disk space and ensure system stability, it's a good idea to regularly delete these.

To do this, shut down all applications, then delete all the *.tmp files from your c:\windows\temp folder. Note: never delete .tmp files if you have applications open, otherwise you could lose data.

It's also a good idea to regularly run the ScanDisk, Disk Defragmenter & Disk Cleanup utilities that come with Windows Me/98 (click Start, Programs, Accessories, System Tools).

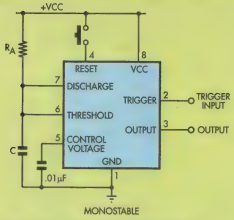


Fig.1: this is the standard circuit for a monostable using a 555.

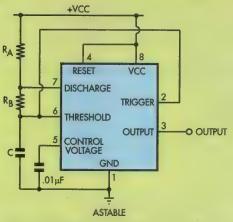


Fig.2: the standard circuit for an astable timer, is unchanged when using the ZSCT1555.

A new 555 timer – it operates down to 0.9V

The ubiquitous 555 timer has for most of its life been manufactured in greater volumes than any other linear IC. Zetex has now produced a new variant of the timer chip which is even more versatile and pulls less power than a CMOS version.

By LEO SIMPSON

When it was first introduced by Signetics back in the early 70s, the 555 seemed like a solution looking for a problem. Given the job of producing a circuit for it back then, as I worked for "Electronics Australia", I racked my brains until I came up with a photo-timer (published in May 1973).

Now, it seems inconceivable that such a versatile device as the 555 could have been regarded in this way. It is now acknowledged by many as one of the most successful ICs, perhaps only equalled in fame by the 741 op amp.

The success of the 555 can be attributed to its flexibility, performance and its ability to satisfy the timing requirements of a huge number of applications. Over the years the original 555 has been supplemented by CMOS versions which operate on much lower current and at lower voltage.

The new 555 timer from Zetex takes the performance to the next level – operation from a single cell, guaranteed operation down to 0.9V and bipolar technology.

To help with the design, Zetex turned to its long-term associate Hans Camenzind, of Array Design, California. He was responsible for the original 555 produced by Signetics.

The new version of the timer, called the ZSCT1555, has the same pin-outs as the original and with the simple adjustment of external components to set the frequency, its function is just the same.

As an example, the following equations are used to calculate the values of the external components for the familiar monostable and astable circuits as shown in Fig.1 & Fig.2.

Monostable: *time t = 1.63RAC*

Astable: *frequency f = 0.62/(RA + 2RB)C*

As already noted, the most significant advantage of the new 555 timer is its guaranteed operation down to 0.9V; better than any CMOS alternatives. This means that it can work with a single cell and still give quite good battery life (ie, down to 0.9V). And even though the ZSCT1555 is a bipolar device, it has a lower current consumption than a CMOS version.

Assuming a 5V supply, a typical CMOS 555 device (eg, 7555) draws 170µA while the new Zetex device pulls 140µA, and at 1.5V just 75µA. In addition, the output sink current is better than that of CMOS versions, up to a maximum of 100mA. Output source current is 150µA (maximum). Maximum supply voltage is 6V.

Thermal performance is improved too, with a better temperature coeffi-

cient and an operating temperature range of -20°C to 100°C.

The graph in Fig.3 shows the ZSCT-1555 quiescent current versus supply voltage characteristic. As you can see, the current consumption is very low for supply voltages below 1V – ie, below 60µA – and this further extends battery life. Of course, the actual current drain from a timer circuit will depend on the timing components and the loading conditions at the output, pin 3.

Single cell boost converter

Given that the ZSCT1555 will run from a single cell, it is appropriate that it can also function as the heart of a single cell boost converter. For any portable, battery-powered application, extended battery life is not the only consideration. Reducing size and weight is also very important. Until recently it has been usual for portable circuits to operate with up to six cells (9V). With this circuit, only one cell is required.

As shown, the circuit is set to deliver a nominal 5V. The ZSCT1555 generates the required 150kHz signal for the PWM circuit while diode D1 allows for very short pulses to be delivered.

Inductor L2, transistor Q3 and Schottky diode D3 provide the main boost converter circuit while L1, D2 and Q2 provide an active speed-up to the base drive to Q3. This minimises switching losses. The transistor specified for Q3 has very low saturation voltage, equating to an on-resistance of only 30mΩ at 300mA, which further optimises circuit efficiency.

The output voltage is regulated by the circuit involving U3, a shunt regulator, and Q4 which modulates the control input on U2, the ZSCT1555.

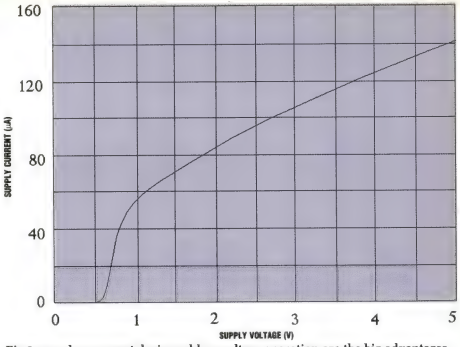
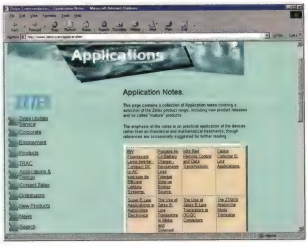


Fig.3: very low current drain and low voltage operation are the big advantages of the ZSCT1555 version of the venerable 555 timer.



Looking for more information on the ZSCT1555 timer IC? Point your browser to www.zetex.com

Acknowledgement: this article is based on an application note published by Zetex plc, UK. The ZSCT-1555 is available from Farnell Components. Phone 1300 361 005. **SC**

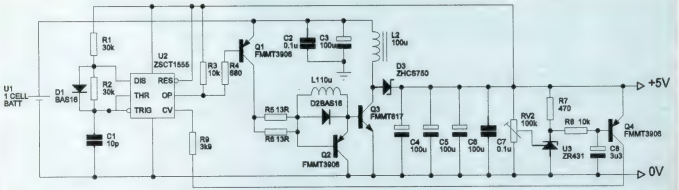


Fig.4: capitalising on its low voltage operation, this boost circuit produces 5V from a single cell.

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

A collector in the west: Keith Lang

Quite a few vintage radio enthusiasts now have interesting and extensive collections of old radio receivers. One such enthusiast is Keith Lang from Western Australia.

A couple of years ago, during a trip to Esperance in Western Australia, I took the opportunity to visit vintage radio enthusiast Keith Lang. Keith retired from farming in 1993 at the age of 69 and wanted an interesting hobby to fill in some of his spare time. Having been involved in radio and electrical activities for most of his life, he decided that vintage radio would be a rewarding pastime.

Keith's interest in radio started in 1934 at the tender age of 10, when he built his first "wireless" – a crystal set (doesn't every collector start with a crystal set?). The coil was wound on a cocoa container which consisted of a cardboard cylinder with metal ends but it was the earth that was really unusual. It consisted of an defunct car radiator buried in the ground, with the earth lead from the set connected to it. Water was poured into the radiator and, because of the many small holes that leaked water and the large surface area, it was very effective.

The aerial was the ubiquitous "long and high" outdoors type, which was typical of the era. However, like most youngsters of the era (and grown-ups too), Keith was reluctant to part with seven shillings and sixpence for a "wireless licence" for his crystal set. Hence the antenna grew at night and withered during the day.

When WWII came, Keith joined the army and became involved with Signals Maintenance and Training, which meant he gained a good overall knowledge of radio transmitters and receivers. Some sets that he recalls working with were the 11, 108 and 19 sets, all considerably more complex than the average radio receiver of the day.

After the war, he became a motor mechanic for a few years, then took up farming. Many other activities kept him busy when there was a lull in farming activities, such as being a motor mechanic, drilling 250 water bores and generally, as he put it, being a "jack of all trades".

One interesting activity involved rewinding Dodge car generators so that they supplied 32V DC for home lighting or DC voltages for other purposes. I saw one of the rewound armatures and it was most professionally done. Many small towns in the 20s, 30s and 40s also had small DC power reticulation systems and Keith had quite a bit to do with them too.

This home-made kitset mantel receiver (circa 1946) came in a stylish wooden case and has been fully restored. It featured inductance (Ferrotune) tuning.

High-voltage DC sets

There were both AC/DC and pure DC sets in some of the areas in which Keith lived, as many towns used only 250V DC supply reticulation. In fact, this was still the case in Esperance in 1958, when Keith moved there. Of course, all DC mains supplies have long since been replaced with 240V AC mains.

In their time, DC mains supplies served small towns quite well. In some cases, the power was only on for certain periods of the day and would go off at night "after the flicks had finished". The power would then come

on again early in the morning. In other cases, batteries were used during periods of light load and/or to supply energy during heavy load periods.

Keith is quick to point out the care needed to service the AC/DC and pure DC radios which ran off the 250V DC mains. He strongly recommends that restorers working on AC/DC sets use an isolating transformer on AC mains, as one side of the mains may be connected to the chassis – and it can easily be active 240V above earth! This is deadly if you touch the chassis and an earthed object at the same time.

Most such sets can easily be wired so that the Neutral is attached to the chassis, or the neutral busbar (if fitted) – but always check. Isolation transformers cannot be used on DC mains or pure DC receivers and servicemen had to be extremely careful when servicing such receivers.

(Editorial note: AC/DC sets in which one side of the mains is directly connected to chassis are "death traps". Do not operate or work on such sets unless you are very experienced and understand exactly what you are doing. The same goes for high-voltage DC sets).

Restoration

Keith especially enjoys restoring wooden console cabinets, so that they look like new. The internals are treated with equal care – the sets are often stripped down to a bare chassis which he then sandblasts using a special attachment he has for his air compressor. A lathe is used to turn up various parts and to wind coils and power transformers.

A counter attached to the lathe is used to count the number of turns when winding a coil or transformer. Unfortunately, not many vintage radio collectors have this type of equipment or the skill to use it.

There is also a good range of hand tools and test instruments in the workshop. These include digital and analog multimeters, an oscilloscope with a component testing facility, a capacitance meter, a signal generator and several valve testers. It is always nice to have an extensive range of test equipment for fault diagnosis and the equipment necessary to make replacement parts.

Recently, Keith restored a 1933 Raycophone "Pee Wee" receiver. This is a rather rare set and has a circuit that's similar to the simple superhets described in the April 2000 issue. After restoration, its performance was initially quite poor and tracking down this problem took some time.

Another stylish receiver in Keith's collection is this Philips table model.

This multiband portable transistor radio included a flip-up lid with a world map that showed the locations of major shortwave stations.

In the end, it turned out to be an incorrect resistor value in the cathode of the converter stage. Replacing this with the correct value resistor cured the problem and the set now performs

Keith's collection includes a good range of early transistor radios, including a compact "purse" receiver (next to the matchbox).

quite well.

Keith's extensive vintage radio collection, like so many others, has grown like "topsy" and very few of the sets are displayed at their best – although two lovingly restored consoles reside in the lounge. One of these, shown in one of the photos, is a 1935 AWA Bandmaster 365B battery console using a 34, 1A6, 34, 30, 32 and a 33 valve line-up. The set is powered from the 240V AC mains via one of Keith's home-made battery eliminators.

None of the many battery valve sets in the collection has been converted to direct mains operation. Instead, a separate mains-operated DC supply has been built for each set. Conversely, all the transistor portables in the collection run on batteries as it is easier to operate them this way and saves dragging an AC lead along with the set.

One of the photographs shows an HMV 601 "portable" set (AORSM Vol. 4 Page 147) which can operate from four sources of power – internal batteries, external batteries, an external AC power supply and, most interestingly of all, a 2V vibrator pack. Yes, that is right, a 2V vibrator pack!

A considerable portion of Keith's collection consists of portable radios, both valved and transistorised. The valved portables include the following brands: Philips, Astor, Healing, STC, AWA, HMV, Kriesler, Ferris and an English "Dynatron".

The smallest is a "purse" radio which is smaller than a pack of cigarettes and is seen in a collection of personal portables in one of the photographs. It boasts five transistors and is powered by a single AA cell, since there was no room for anything bigger.

The most elaborate Australian-made transistor sets are three AWA units. These receivers appear to be identical until a close inspection is made. Two are broadcast band sets with an RF stage but different dial scales, while the third is a 4-band unit which tunes from 550kHz to 30MHz. Quite a number of small Japanese sets are also tucked away on a shelf.

Car radios also feature strongly and include examples from AWA, Ferris, Philips, National and Astor. The intriguing ones are the Ferris M104 and M106 models, which can be powered from various sources.

Another unusual item is a home-made set using the Kingsley Ferrotune front end kit, produced around 1946 (see photo). A few manufacturers produced inductance tuned radios for household use, such as Radio Corpo-

A close-up view of the Ferrotune inductance tuning module (at left), as used in the home-made receiver.

ration, Philips and AWA.

There are also a few black and white TV sets in the shed waiting for restoration but there are many more radios in the queue ahead of them.

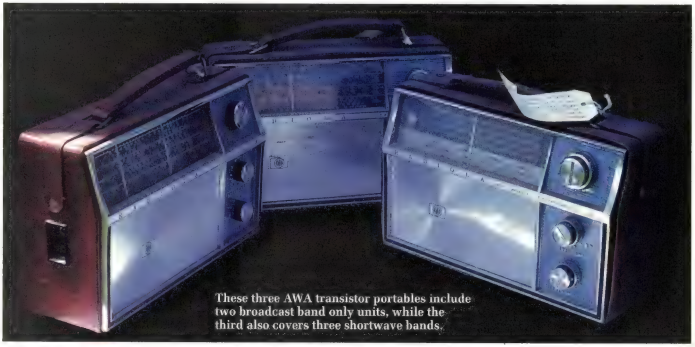
I asked if there were many collectors around the Esperance area and he replied that he knew of only one. This means that there is very little competition when it comes to obtaining sets at reasonable prices. On the downside, there is virtually no-one to share experiences or discuss problems with.

Keith has obtained his radios from quite some distance in some instances – eg, Albury (NSW) and Peterborough (SA). Closer to home, sets have come from Kalgoorlie and Boulder. Garage sales are a good source of receivers and generally keeping your eye out for them and letting people know of your interest will pay dividends. He has no particular favourite set or style, except that they should be wooden cabinet radios from the mid 1930s to early 1940s and Australian made.

Keith's collection reflects a slightly different emphasis compared to the average eastern states collector. Some of the sets were different due to local conditions, as was some of the equipment used.

But basically we're all interested much in the same thing – the retention of our technical history and the restoration of old receivers. It would be interesting to swap experiences with a vintage radio buff from across the Tasman! **SC**

Keith's pride and joy is this 1935 AWA Bandmaster 365B battery operated set.



These three AWA transistor portables include two broadcast band only units, while the third also covers three shortwave bands.

PRODUCT SHOWCASE

Fluke 180 Series Digital Multimeters

Fluke Corporation has introduced the model 187 and 189 digital multimeters which include RMS voltage, temperature measurement, real time clock, data logging and PC communication.

The 180 Series have .025% accuracy and 50,000 counts of resolution. They have a multiple reading display for simultaneous readouts such as True RMS, AC + DC, Hertz, dB, mV DC and a real-time clock. Measurements include volts, ohms, continuity, diode test, amps and capacitance, as well as temperature in Celsius and Fahrenheit.

In addition to relative mode and Min/Max/Average, the 187 and 189 offer a Fast Min/Max mode for capturing transients as short as 250 femtoseconds.

The Fluke 189 can be set up to

capture and store measurement data while unattended. In the logging mode, the meter monitors all changes in the input signal and then stores a summary of those changes based on a timed interval, as well as the stability of the measured signal. Once the logging session is complete (up to three days), the stored information is downloaded to a PC using the optional FlukeView Forms software.

The closed case calibration feature of the 180 Series allows calibration adjustments to be made directly from the front panel or through the infrared port. The battery access door enables the user to change batteries and fuses without breaking the calibration seal.

The new 180 Series DMMs meet the IEC-61010 CAT III 1000V and CAT IV 600 V safety ratings and carry a dustproof and drip-proof environmental rating.

A multi-language CD-ROM containing the user's manual is also included with the meter.

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Extech programmable LCR meters

These new programmable LCR meters from Extech are suited to manual or fast automatic component testing on production lines. Both can provide comprehensive test reports via an optional printer interface and they include the following features: 100-test parameter data memory; hi/lo limit setting and bin sorting.

The instruments measure impedance, inductance, capacitance and dissipation factor, as well as equivalent series resistance (ESR) and DC resistance. The model 8323 has test frequencies of 100Hz, 120Hz, 1kHz and

10kHz while the model 8326 adds 100kHz and an optional swept frequency mode from 40Hz to 200kHz.

Test fixtures available include 4-wire Kelvin clips, SMD test probes and shorting bars.

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WebDAQ is the world's first data acquisition device to use embedded web server technology. The benefit compared to existing data logging systems is that there is no driver to install. Simply plug WebDAQ into your computer's Ethernet port or a network wall socket, open your web browser and type in WebDAQ's IP address.

WebDAQ's flexibility and ease of use makes it ideal for any data logging applications, from laboratory and research environments through to production and process control. It's main features include: 500kHz throughput with 12-bit accuracy on 32 channels, eight D/A output channels, digital and analog triggering, sampling at multiple data rates simultaneously and built-in sensor scaling and conversion to engineering units.

Easy-to-use screens let you configure your acquisition parameters, start and stop operations and define data reports. When you want your data, just click and download the file the same way you would download any file from the internet. You can even download directly into Excel.

WebDAQ can schedule automatic reports and automatically email them to any email address or upload data to an FTP server for later use. WebDAQ can also act as a workgroup server, with multiple users accessing data reports, with the added protection of user passwords if required.

WebDAQ works in a PC, Mac, Unix or Linux environment.

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Reference book for upgrading and repairing PCs

Want to upgrade your PC? Then have a look at the 12th edition of Scott Mueller's "Upgrading and Repairing PCs", now available from all Dick Smith Electronics stores. This updated edition features new and revised illustrations, including step-by-step photos showing how to build a PC from scratch.

There are also sections on how to install a network in a home or small office, how to supercharge a PC for high-level game performance and how to set up high-speed internet connectivity at home.

It comes with a 90-minute CD-ROM "how-to" video presented by Scott Mueller. Additional information, including frequently asked questions and technology updates are available on the companion website www.upgradingandrepairingpcs.com.

The retail price is $99.89.

Speaker ports for bass reflex enclosures

Altronics have recently added three new flared loudspeaker ports to their range. The flared design reduces air turbulence (the rushing noise) which can occur when the air velocity in the port exceeds about 5% the speed of sound.

In simple terms, the flared port allows you to produce loudspeaker cabinets which have reduced distortion at high power levels compared to conventional ports.

The ports are of ridged plastic construction and have a push-in mount under the flare for flush mounting. Sizes and prices are $2.90 for the 35mm diameter 120mm long model (Cat. C-3627), $4.15 for the 50mm x 145mm model (Cat C-3629) and $10.85 for the 100mm x 200mm model (C-3633).

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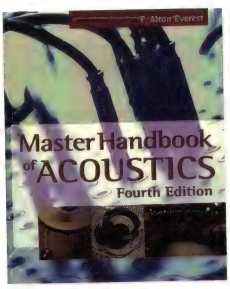
BOOK REVIEWS

Reference on acoustics

The Master Handbook of Acoustics, by F. Alton Everest. 4th Edition, published 2001 by McGraw-Hill, USA. Soft covers, 184 x 232mm, 616 pages. ISBN 0 07 136097 2. Price $59.95.



This one of the best books on audio theory and practice that I have ever come across. It is very readable and you can pick it up virtually anywhere in any chapter and get useful information straight away. There is a minimum of mathematics and formulas so that anyone from the novice to an engineer will find it worthwhile.

All told there are 28 chapters plus an appendix so I am not going to list all the contents; a sample will have to do.

The book starts off with some basic audio theory, sound levels and the decibel, the ear and perception of sound. It then goes on to cover speech, music and noise, analog and digital signal processing (DSP), reverberation and control of interfering noise.

From then on there are separate chapters on reflection, diffraction, refraction and diffusion of sound, modal resonances and reflections in enclosed spaces and comb filter effects.

All of these chapters are of particular interest whether you are professionally involved in acoustics or perhaps you are doing home renovations and want to achieve some control of the domestic acoustic environment.

As you read this book, you will find out that soft furnishings such as curtains and carpet have very little effect on room acoustics, particularly at the lower frequencies. If you want to make real progress you will have to play around with Helmholtz resonators and other absorbers.

Other chapters are devoted to quiet air for the studio (minimising air-con noise etc), acoustics of listening rooms and small studios, acoustics of the control room and for multi-track recording, adjustable acoustics, acoustical distortion and finally room acoustics measurement software.

To sum up, if you are involved in acoustics in your work or you are a keen audio enthusiast at home, this book is very useful. I can thoroughly recommend it. Our copy came direct from the publishers. (L.D.S.)

How to build small robots

The Robot Builder's Bonanza; 99 inexpensive robotics projects, by Gordon McComb. 2nd edition published 2001 by McGraw-Hill. Soft covers, 187 x 234mm, 754 pages. ISBN 0 07 136296 7. Price $44.95.

Most people wanting information on robotics these days go directly to the inter-net and there is a heap of information there.

However, sifting the wheat from the chaff is time-consuming and there is a great deal of chaff.

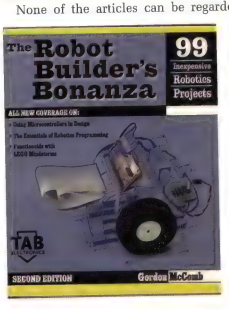
Hence this just released book from McGraw-Hill is very timely. Note that it is written for the USA and mentions parts outlets over there.

However, Australia appears to be much better served with electronics parts retailers in the form of Dick Smith Electronics, Jaycar Electronics, Altronics and other firms; the poor Americans can only dream of how good it is in Australia and New Zealand.

Having said that, you should find few problems in obtaining all the electronics parts or their equivalents. Some of the mechanical parts may be a little more difficult but the larger hardware stores and hobby shops are pretty good in this respect. The servos discussed should present no problems with availability.

Most of the robot projects described assume that you have good metal-working skills and the same thing applies as far as electronics work is concerned. There are no PC boards and it is assumed that you will assemble all the circuits on protoboards or Vero board. Some of the articles make use of Lego, Meccano and Fischer-Technik parts and again, these are all available in Australia and New Zealand.

None of the articles can be regarded as step-by-step constructional articles as you would expect to see in this magazine. Instead, you are given a fairly brief overview and then it is up to you. There are lots of photos (black and white) but they are fairly ordinary in quality and lack contrast and sharp detail.



All up, there are 42 chapters and five appendices. We'll mention a few of the chapter

(Continued on page 93)

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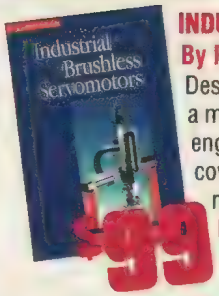

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By Peter Moreton. Publ. 2000

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By John Linsley Hood. First published 1995. Second edition 1999.

This book is for anyone involved in designing, adapting and using analog and digital audio equipment. It covers tape recording, tuners and radio receivers, preamplifiers, voltage amplifiers, audio power amplifiers, compact disc technology and digital audio, test and measurement, loudspeaker crossover systems, power supplies and noise reduction systems. 375 pages in soft cover.

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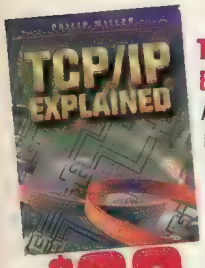

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TCP/IP EXPLAINED

By Philip Miller. Published 1997.

Assumes no prior knowledge of TCP/IP, only a basic understanding of LAN access protocols, explaining all the elements and alternatives. Combines study questions with reference material. Examples of network designs and implementations are given. 518 pages, in paperback.

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THE CIRCUIT DESIGNER'S COMPANION

By Tim Williams. First published 1991 (reprinted 1997).

Includes grounding, printed circuit design and layout, the characteristics of practical active and passive components, cables, linear ICs, logic circuits and their interfaces, power supplies, electromagnetic compatibility, safety and thermal management. 302 pages, in paperback.

LOCAL AREA NETWORKS: An Introduction to the Technology

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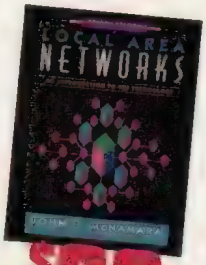

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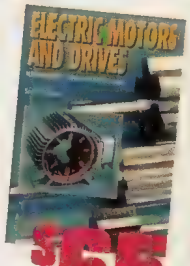

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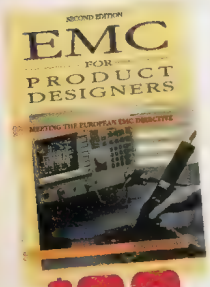

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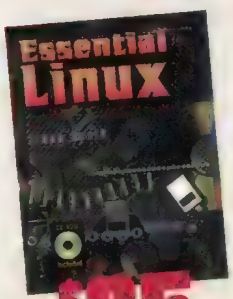

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April 1999: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/Thermometer; Build An Infrared Sentry; Rev Limiter For Cars; Electric Lighting, Pt.13; Autopilots For Radio-Controlled Model Aircraft.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1: Three Electric Fence Projects; Heart Of LEDs; Build A Carbon Monoxide Alarm; Getting Started With Linux; Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades Without Reinstalling Software; What Is A Groundplane Antenna?; Getting Started With Linux; Pt.4.

July 1999: Build The Dog Silencer; A 10µH To 19.99mH Inductance Meter; Build An Audio-Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; X-Y-Z Table With Stepper Motor Control, Pt.3; The Hexapod Robot.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Temperature Controller; X-Y-Z Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14; DOS & Windows Utilities For Reversing Protel PC Board Files.

September 1999: Automatic Addressing On TCP/IP Networks; Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Electrolytic Capacitance Meter; XYZ Table With Stepper Motor Control, Pt.5; Peltier-Powered Can Cooler.

October 1999: Sharing A Modem For Internet & Email Access (WinGate); Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: USB – Hassle-Free Connections TO Your PC; Electric Lighting, Pt.15; Setting Up An Email Server; Speed Alarm For Cars, Pt.1; Multi-Colour LED Christmas Tree; Build An Intercom Station Expander; Foldback Loudspeaker System For Musicians; Railpower Model Train Controller, Pt.2.

December 1999: Modem Connection Sharing Using Hardware; Electric Lighting, Pt.16; Build A Solar Panel Regulator; The PC Powerhouse (gives fixed +12V, +9V, +6V & +5V rails); The Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Volume 12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Picman Programmable Robot; A Parallel Port Interface Card; The Serial Interface For Telephone Lines; B&W Nautilus 801 Monitor Loudspeakers (Review).

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator; Marantz SR-18 Home Theatre Receiver (Review); The "Hot Chip" Starter Kit (Review).

March 2000: Doing A Lazarus On An Old Computer; Ultra-Low Distortion 100W Amplifier Module, Pt.1; Electronic Wind Vane; 16F876-LED Display; Glowplug Driver For Powered Models; The OzTrip Car Computer, Pt.1; Millohm Circuit Design & Simulation Package (Review).

April 2000: A Digital Tachometer For Your Car; RoomGuard – A Low-Cost Intruder Alert; Ultra-LD Mixer Amplifier; The OzTrip Car Computer, Pt.2; Build A Temperature Logger; Atmel's ICE 200 In-Circuit Emulator; How To Run A 3-Phase Induction Motor From 240VAC.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost AT Keyboard Translator (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models; What's Inside A Hard Disk.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF FM Receiver; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor For Cars Or The Home.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; 8-Channel Musician's Lead Tester; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2; Say Bye-Bye To Your 12V Car Battery.

August 2000: Build A Theremin For Really Eerie Sounds; Come In Spinner (wireless messages in "thin-air"); Loudspeaker Protector & Fan Controller For The Ultra-LD Stereo Amplifier; Proximity Switch For PIC/VAC Users; Unstructured Cabling For Computer Networks.

September 2000: Build A Swimming Pool Alarm; An 8-Channel PC Relay Board; Fuel Mixture Display For Cars, Pt.1: Protoboards – The Easy Way Into Electronics, Pt.1; Cyborg The Solar Fly; Network Troubleshooting With Fluke's NetTool.

October 2000: Guitar Jammer For Practice & Jam Sessions; Booze Buster Breath Tester; A Wand-Mounted Inspection Camera); Installing A Free-As-Software Web Server; Fuel Mixture Display For Cars, Pt.2; Protoboards — The Easy Way Into Electronics, Pt.2.

November 2000: Santa & Rudolf Christie Display; 2-Channel Guitar Preamplifier, Pt.1: Message Bank & Missed Call Alert; Electronic Thermostat; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access: Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Build A morse Clock; Protoboards – The Easy Way Into Electronics, Pt.4; Index To Vol.13.

January 2001: LP Resurrection – Transferring LPs & Tapes To CD; The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator, 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed; Wireless Networking.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; L'il Pulser Train Controller; Midi-Mate – A MIDI Interface For PCs; Build The Bass Blaster; 2-Metre Elevated Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Driving Your Phone from A PC; Making Photo resist PC Boards At Home; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Checkerboard; Protoboards – The Easy Way Into Electronics, Pt.5; More MIDI – A Simple MIDI Expansion Box.

PLEASE NOTE: November 1987 to March 1989, June 1989, August 1989, December 1989, May 1990, February 1991, June 1991, August 1991, February 1992, July 1992, September 1992, November 1992, December 1992, May 1993, February 1996 and March 1998 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.70 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disk for $11 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

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White noise generator for tinnitus treatment

I am looking for a white noise generator to help my mother who has tinnitus. As far as I can determine from the (limited) published literature, the white noise generator works by distraction only. You may find the following website useful:
http://www.gold-line.com/pwn1.htm

As far as the medical literature is concerned, the condition is poorly understood and treatment options are limited. I suspect someone tried white noise on a patient, it worked, and it then found its way into the literature. My understanding is that low level noise helps in retraining the brain. Anyway, what can you suggest? (G. M., via email).

● We have not described a white noise generator but we have described a pink noise generator in the January 1997 issue and it was also featured in our recent publication "Electronics TestBench". It should serve the purpose although it would be easy to remove the "pink" filter components to make the noise "white".

White noise has a uniform energy spectrum; it rises at 3dB per octave. Pink noise is white noise with a 3dB/octave filter applied to give equal energy per octave. As far as tinnitus is concerned, the effect of pink noise would be exactly the same as white noise.

Query on UHF remote switch

I am interested in the "UHF Remote Switch" featured in the December 1989 and August 1990 issues of SILICON CHIP. Before procuring photocopies or back copies of the relevant articles I have a couple of queries.

I understand that the RF transmitter is based on discrete components. Does the design for the RF receiver portion use a pre-built module or is it also based on discrete components? If it uses a pre-built module, do you know if this is still easily obtainable?

I am particularly looking for a design for the RF section of a 308MHz remote-control receiver to interface with an MC145028 that uses readily available parts and I favour one that uses discrete components. (J. P, via email).

● The design in question is very old and you might want to use a later one. The transmitter has a Motorola 41342 encoder chip which may not be available now. The receiver does not use a prebuilt module. Later designs do. Check out the designs in February 1996.

More 12V outlets from PC PowerHouse

I am in the process of building the PC PowerHouse, described in the December 1999 issue of SILICON CHIP. I would like to change the 5V outlet to 12V (thus having two 12V outlets).

Another idea I have would be to purchase a used PC power supply and (either with or without the PC Powerhouse kit) use this unit to supply another two or more 12V outlets (without a PC). How can this be done? I don't have much need for the lower voltages. (A. Z., via email).

● If you don't want the lower voltage outputs, you can have up to three 12V outputs simply by placing a link across each of the 3-terminal regulators. If you want to use a PC power supply direct and you only want 12V, you don't need the PC PowerHouse at all – just use the 12V directly from the power supply.

Switched capacitor speed control for fan

We have a ceiling fan about 10 years old (maybe a bit less). It came with a multi-tap choke control, which was not installed. Instead, a solid-state Clipsal fan control was used, together with a SPDT centre-off Clipsal switch, enabling the fan to be run full bore, bypassing the control, or through the variable control. This was done purely for aesthetic reasons. The original choke control has been lost.

Now the solid-state control has died (the fan works when the switch is set to bypass the control but won't work via the control). The new fans one buys now use a multi-position switch

Frequency change for Tandy R/C cars

I have recently purchased two radio-control cars for my children from Tandy Electronics. The problem is that the two cars are both on the same frequency, 27.145MHz . I had thought of changing the crystal in one of the cars but it only has one in the transmitter, not the receiver. What should I do? (C. O., via email).

● If there is only one crystal in the system and it is in the transmitter, it is possible that the receiver is a super-regenerative type with a bandwidth of around 2-3MHz. That means that you can only operate one receiver at a time on the 27MHz band. According to our R/C guru, Bob Young, this is how radio-control began back in the olden days. They flew one model on 27MHz and the other on 40MHz. Then along came superhets and changed everything.

According to Bob Young, if it is one of the modern super-regen receiver chips, it could possibly have a bandwidth of only 200kHz which may make it possible to squeeze one transmitter in at the bottom (26.995MHz) and another at the top on say, 27.255MHz. If you want to try it, Silvertone Electronics can supply crystals cut to those frequencies if required, at $21.50 each. See their advertisement elsewhere in this magazine.

to switch in different capacitor values in series with the fan.

I would like to replace the faulty solid-state control with one of these capacitor ones, as it will free up a position in the switch plate, to be used for an extra light. Will the new capacitor controls (a Clipsal one) work with the older fans or are the motors different now? I don't want to just go out and buy a capacitor control only to find it either won't work or it ruins the fan motor.

Of course, it may well turn out to be cheaper to buy a new fan, the way prices of things are these days. (J. B., via email).

● Trying a switched capacitor control could be a bit of a lottery – we don't know whether the new fan motors differ substantially from the old one.

Why don't you just fix the solid state control? It is likely to need a new Triac. We published an article on fixing light dimmers in the November 1996 issue. You can also buy switch plates which will accommodate three switches – or one switch either side of the dimmer module. We can supply the November 1996 issue for $7.70 including postage.

By the way, Triac fan speed controllers are now available quite cheaply from hardware stores.

More range wanted from speed controller

I have just successfully completed the Universal Motor Speed Controller described in November 1992 and put it to good use. However, the power tool I am using with it does not run at full speed. In fact, the measured output line voltage with the tool running is only 145VAC.

I am using a Dremel Moto-Tool, rated at 110W and 0.48A, running at 30,000 RPM. Is this as expected or is there a modification to the controller that I could make? (G. C., via email).

● The unit is working pretty much as expected. The circuit is essentially a controlled rectifier and so in theory, the maximum output voltage to the motor is about 170VAC.

If you want control over the full range of a motor, including full speed, you need to build the 10A 240VAC speed controller described in the November 1997 issue. We can supply this issue for $7.70 including postage.

High energy ignition will not start car

I purchased the High Energy Ignition kit from Jaycar Electronics, assembled it without any problems, connected it into my daughter's Datsun 200B and the car will not start. It spins over OK but there is no spark getting to the plugs.

The Jaycar people have looked at it and couldn't see anything that was obviously wrong with it. They gave me a replacement IC in case the original was faulty but this didn't help. Do you have any suggestions? (D. M., Canberra, ACT).

● You really need to do a bench test on the ignition system, with a coil fitted. You do not say whether the car has points but you need to simulate the closing of the points (or whatever the pickup is) to see that a spark is being delivered by the coil.

The coil should have a spark gap from the HT connection to one of the primary terminals. You can do this with a paper clip and arrange for a gap of no more than 6-8mm. If you operate the coil without a spark gap, you may blow it internally.

We doubt whether the IC would be at fault. The most common problems with any kit are missed solder joints or shorts due to fine solder splashes across the tracks.

Zener diode tester availability

I am inquiring as to who may still be supplying the kit for the Zener Diode Tester described in the March 1996 issue of SILICON CHIP. If there is no supplier, where can I obtain the harder to get parts such as the Philips transformer assembly and its parts, the 1N4936 fast recovery diode and the 56V 3W zener diode. (D. S., via email).

● The kit for the Zener Diode Tester is no longer available. The PC board can be obtained from RCS Radio. Phone (02) 9738 0330. The EFD20 transformer is available from Farnell Electronics; phone 1300 361 005. Catalog numbers are 200-270 for the core (2 required), 200-281 for the bobbin (1 required) and 200-293 for the clips (2 required). The 56V zener (368-428) and the 1N4936 diode (366-950) are also available from Farnell.

Cheaper transformer for 500W amplifier

I was interested in building the 500W amplifier described in SILICON CHIP during 1997. I just want to find out if I could substitute a cheaper transformer or if there is some other way I could power the amplifier for a lower price.

Just recently, I went to the Altronics website and saw they have a 50V + 50V 500VA toroidal transformer (Cat M-5750). Is this transformer going to suit the design? (B. B., via email).

● A 500VA transformer is nowhere near big enough if you really want 500W output. The rule of thumb is that a class-B amplifier is about 60% efficient at maximum power and if you do the sums, you need 833VA. That's why we specified 800VA. Also 50V a side is a big reduction on the 57V specified and that would mean a reduction in power output of about 23% or about 380W maximum. We're afraid there isn't any easy answer.

TENS kit wanted

I'm after a TENS kit as featured in SILICON CHIP, August 1997. I have tried Dick Smith Electronics but have been told they are no longer available. Could you help in obtaining one please? (T. S., via email).

● While this kit is no longer produced, all the parts should be readily available. The PC board can be purchased from RCS Radio. Phone (02) 9738 0330 or www.cia.com.au/rcsradio

Ultra-low distortion amplifier query

I bought a pair of low distortion amplifier modules (published by SILICON CHIP in March & May 2000) from Altronics, thinking that they would be perfect for a subwoofer project I am doing. Unfortunately, I bought the modules sight unseen, having not read

Adding a kill switch to the 5-band equaliser

I was considering adding the 5-band equaliser from your December 1995 issue, to my mixing console. I was wondering if I insert a notch filter or similar on each of the bands to effectively cancel them when not needed; similar to the kill switches found on DJ mixers.

Or maybe I could extend the ranges from the usual ±15dB on each band. A kill switch beside each pot control would also be effective. Is this possible? (E. Z., via email).

● The kill switch probably does not introduce a notch at the frequency selected but simply restores the equaliser band to flat. This could be implemented by switching the wiper of the control pot to a second resistive divider across the pot. The resistors would each be 22kΩ.

Extra boost and cut can be achieved by changing the 10kΩ resistor between pins 10 & 14 of IC1. A larger value will increase the boost and cut.

Adding a fixed resistor in series with the pot will restrict the control range. One in the top will restrict the boost and one in the bottom will restrict the cut.

the original articles. I need to use the modules to drive 4Ω loads and note that this impedance is not recommended.

Can any modification be performed to improve reliability (force more equal current sharing)? Your article notes that emitter resistors were tried on the output devices but they increased distortion.

In my application, ultra-low distortion is not needed and I won't be feeding them anything above 200Hz. My intended bass driver has dual voice coils. The plan was to feed each voice coil from a separate amplifier. (P. H., via email).

● There is no easy or effective modification to make these modules suitable for 4Ω loads. The ideal choice would have been to pick our Plastic Power module (175W into 4Ω) published in April 1996 but not available from Altronics. Your best course may be to ask for a credit and buy the Altronics Mosfet amps (K-5170) which are rated for 200W into 4Ω. Their distortion is nowhere near as low (despite being quoted at .007%) but they would be quite suitable for your application.

Fuses for toroidal transformers

Last week, the transformer on our church equaliser went open circuit on the primary side. No other faults were noted and the fuse was intact.

As a new transformer is $60-80 and 10 weeks away, I was advised to substitute a 15V toroid, which I have done (Jaycar MT-2086). The EQ unit had a 150mA 3AG fast-blow fuse which blew immediately at power up when testing the toroidal transformer but with a higher-rated fuse the transformer is putting out the correct voltages.

I recall some time ago reading that toroids have a high inrush current and require higher-rated fuses than conventional transformers but cannot find reference to the information anywhere. I note that the LP Doctor described in January 2001 uses a 1A slow-blow despite the obviously minimal current of the operating circuit and assume the fuse type is to prevent the problem I am observing. Should I use a slow-blow type fuse? (G. C. via email).

● The fuse in the LP Doctor is wrong. It should have been 150mA slow-blow. We suggest that you use the same value for your EQ unit. The article on fuse protection in toroids was published in the March 1995 issue. We can supply it for $7.70 including postage.

Turbo timer runs at switch-on

I have installed the Turbo Timer, described in the November 1998 issue, on a Toyota 2.2 litre 4-cylinder diesel. The problem is that the timer appears to be running as soon as I start the engine for the correct time but it does not run when the engine is turned off. I have checked the wiring a couple of times but cannot find a fault. I must have made a mistake somewhere. Can you please assist? (D. S., via email).

● There is possibly a wiring error on your Turbo Timer, with the 87 and 87a terminals on the relay (RLY1) transposed. Alternatively, the ignition voltage may not fall quickly when it is switched off due to an accessory that is connected to the ignition which has some storage capacitance.

You could try placing a 100Ω 5W wire wound resistor between terminal 87a of RLY1 and 0V (ie, chassis). This should discharge any capacitance across the ignition supply.

Ballast resistor runs very hot

I recently installed a High Energy Ignition System (described in June 1998) into a Subaru Fiori and while the unit works very well, the temperature of both the ballast resistor and the coil worry me a little.

The resistor is so hot it will blister

Fault in high efficiency fluorescent inverter

Can you please assist me with the fluorescent light inverter published in November 1993. I have constructed the unit to suit a 36-40W tube. The light came on OK and a short while later it failed. I replaced the 5A input fuse and as soon as light came on, the fuse went again. Can you help? (P. W., via email).

● With the fluorescent tube out of circuit (disconnected) check that the inverter produces 340V between the drain of Q3 and source of Q4. If not, check that transformer T1 is wound correctly. Windings for the primary are wound by terminating wires at pins 4 & 5 of the transformer and winding both wires for four turns and terminating at pins 7 & 6 respectively. The secondary at 136 turns starts and finishes at pins 2 & 1 respectively. Check that the transformer is correctly oriented on the PC board.

Check the voltages at pin 1 of IC2 and pins 12, 11 & 8 of IC1. These should all be at 12V with respect to ground. Also check the orientation of the diodes and that the zener diodes are in their correct positions.

skin if touched and while the coil is not as hot, it is still quite warm.

I realise that the average DC current will be greater now (about twice) and that the unit is current limited. I am still concerned about the long term effects of the high temperatures, particularly on the resistor. Any comments? (B. S., Canberra, ACT).

● Any high power wirewound resistor will run at very high surface temperatures when running at more than 50% of its rated power. You could always reduce the current limit figure somewhat and also ensure that airflow around the coil and ballast resistor is as unrestricted as possible.

Connecting the theremin to a guitar amplifier

I just purchased a Theremin kit (described in the August 2000 issue) and was wondering if I could replace the line out from an AV type plug to one that could plug into a guitar amp? (L. J., via email).

● Yes, you can connect the Theremin to a guitar amplifier but you will need to reduce the signal level. Connect a 10kΩ resistor in series with the 10µF output capacitor and replace the existing 10kΩ resistor at the output with a value of 1kΩ. This will reduce the Theremin's output from a nominal 500mV to 50mV.

Running two tubes with the fluoro inverter

I intend to purchase a kit for the high efficiency fluorescent inverter from Altronics but I have a question about it. Will this kit run two 20W tubes in parallel? (J. H., via email).

● In existing form, the inverter will not drive two tubes in parallel because once the first tube ignites, there will be insufficient voltage to ignite the second.

The only way to do it would be to have a common 340V supply and then build separate driver circuits (involving transformer T2 and Mosfets Q3 & Q4) for each tube. The easiest way to do that would probably be to purchase an extra PC board (from RCS Radio) and use the driver end of the second board to power the second tube.

Notes & Errata

LP Doctor, January 2001: the specified fuse is wrong. It should be 150mA slow-blow.

PIC Programmer and Checkerboard, March 2001: the text on page 69 (third column) refers to jumper J2 and switches SW3 and SW4. These should be JP2, S11 and S12, respectively. The circuit diagram and overlay are correct.

On the PC board, there is insufficient space to fit the 2200µF 25V filter capacitor but a value of 1000µF 25VW will be adequate. Also the 10kΩ pullup resistor for RA4 on the LCD adapter is not low enough to give reliable operation. Use a value of 4.7kΩ instead.

Bass Blazer, February 2001: some filter PC boards (code 01102011) may not have a connection between pin 4 of IC6 and V+. This connection provides power to IC6. If your PC board has this error, use a short length of fine insulated hook-up wire to connect IC6 pin 4 to the cathode end of D9.

The relevant PC artwork on our website has been corrected.

BOOK REVIEWS – *continued from page 89*

headings. In the introductory section there are chapters on robot basics, tools and supplies, buying parts, common electronic components, electronic construction techniques and fundamentals of programming. Section 2 has chapters on building robot platforms out of plastic, metal and wood, LEGO-based robots and LEGO Mindstorms RCX.

Section 3 is entitled "Power, Motors and Locomotion" and has chapters on batteries, DC motors, steppers and servos.

Section 4 has practical robot projects including a 6-legged walking robot and a few robot arms. Incidentally, how the book comes to be subtitled with "99 inexpensive robotics projects" is a mystery; there are only a few complete robots described.

Section 5 is entitled "Computers and Electronic Control" and has chapters on interfacing computer and Microcontrollers, using the Basic STAMP, the BasicX and OOPic microcontrollers and remote control systems.

Finally, Section 6 is on "Sensors and Navigation" and has chapters on sense of touch, collision avoidance and detection, fire detection, sound input and output, tilt and gravity sensors.

In summary, this is a pretty useful book although, as mentioned above, you need to have reasonable electronics and related mechanical skills to get the best out of it. It also has a good list of web sites for further research.

Our copy came direct from the publisher. (L.D.S.)

Note: the above books are available through major retailers such as Jaycar, Dick Smith Electronics, Altronics and from the Technical Bookshop, Melbourne and other major book retailers.

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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Dunfield C Compilers: Everything you need to develop C and ASM software for 68HC08, 6809, 68HC11, 68HC12, 68HC16, 8051/52, 8080/85, 8086, 8096 or AVR: $198 each. Demo disk available.

ImageCraft C Compilers: 32-bit Windows IDE and compiler. For AVR, 68HC11, 68HC12. $396.

Atmel Flash CPU Programmer: Handles the 89Cx051, 89C5x, 89Sxx in both DIP and PLCC44 and some AVR's, most 8-pin EEPROMS. Includes socket for serial ISP cable. $220, $11 p&p. SOIC adaptors: 20 pin $99, 14 pin $93.50, 8 pin $88.

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HELP SAVE THE NIGHT SKY!

We are losing our heritage of starry night skies. Poor, inefficient outdoor lighting is causing glare and "light pollution". This wastes energy and increases greenhouse gas emissions.

You can help by joining SYDNEY OUTDOOR LIGHTING IMPROVEMENT SOCIETY (SOLIS). SOLIS aims to educate and inform about quality outdoor lighting and its benefits. We also lobby councils, government and other bodies to promote good lighting practice. SOLIS meetings are held third Monday night of each month at Sydney Observatory.

SYDNEY OUTDOOR LIGHTING IMPROVEMENT SOCIETY

Individual membership is $20 pa. Donations are also welcome. Cheques payable to "SOLIS c/- NSAS", PO Box 214, West Ryde 2114.

http://sites.netscape.net/solislp/

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Printed circuit boards for SILICON CHIP projects are made by:

- RCS Radio Pty Ltd. Phone (02) 9738 0330. Fax (02) 9738 0334.

BARGAIN OF THE MONTH

*** * N E W * * N E W * * N E W * ***

FUTABA 2 CHANNEL RADIO CONTROL

This item is new in its original box.

2ER A high-tech, low-priced 2-channel radio This two-stick, digital proportional AM system is ideal for robotics, R/C cars, boats and planes etc. Features include fine trims that are easily accessible on the front panel, Short sticks that allow for full range of movement and Servo Reversing. Includes two S3003 servos, a R122JE receiver, battery holder, power switch and other accessories. All for just $100!

JUMBO SERVO KIT... Use it with a wind-screen wiper style motor or / gearbox of your choice. This kit is designed to work just like a std R/C servo (with much greater power) using 1-2mS pulse width. It has proportional control ie. if you move the joystick a little, the servo moves a little. It can be used with a std. R/C receiver or with our servo controller kit. Some applications inc... R/C models, Robotics, Gates & Doors, Fly by wire control (with our servo controller) of things like Forward controls for outboards (steering, throttle etc), Pan & tilt of Cameras, Antenna dishes etc. Could be used as a winch for sails etc. with the addition of a multi turn pot & a winch drum. Kit includes PCB, all onboard parts, feedback pot & suitable mini case $35 (arm or winch drum not included)

DUAL SERVO CONTROLLER KIT

This is designed to control R/C servos with 1-2mS pulse with. Ideal for use with our Jumbo Servo kit or with std servos. Applications include testing of R/C servos pan and tilt of cameras etc. Std. kit includes PCB all onboard components, suitable case and pots. $14.... Std. Kit plus power supply suitable for powering 1 Jumbo Servo $24

MICRO SWITCHES

3 mini micro switch assembly on a 600mm cable with a small plug. 3 assemblies for $5

SOLENOID: #1

This solenoid pushes a small shaft (diameter 4mm) a distance of 2mm. Coil resistance is 60 ohms. Operates from 12V DC. Body is 29mm long, 22mm diameter: (MA1)

SOLENOID: #2

This solenoid punches a small 1.5mm diameter hole in a piece of cardboard or paper. It was probably used to punch holes in phonecards. Coil resistance is 7ohms. Operates from 12V DC. Body measures 34mm long, 40mm diameter: (MA2) (MA1) + (MA2) $2.20 pair or 3 pairs for $5

Join our Bargain Corner Mailing List

We will send information on latest updates to Bargain Corner and Test Equipment ItemsTo join send a blank email message to: **subscribe@oatleyelectronics.com**

(NEW) MULTI FUNCTION BATTERY CHARGER / DISCHARGER:

New in original box with instructions. This unit was designed to charge NI-CD & NI-MH mobile phone batteries of 4.8V, 6.0V and 7.2V. Operates from 12-24V DC input. Features include processor control & multi stage charge indicator. By changing the value of one resistor it can charge higher voltages, although a higher voltage plugpack is required for 9.4V or higher. Includes cigarette lighter lead, 12V / 1A DC plugpack & instructions for modifications for higher voltages. The unit has battery charging terminals but the user will have to make their own adaptor / interface to a battery. The plugpack supplied alone is worth around $30 retail. Weight is 0.9kg. $29 15V DC / 1A Plugpack for charging batteries 9.4V or higher: (ZA0055) $6 If you ask when ordering you will receive a free 6-pack of batteries.

PENTIUM II MOTHERBOARD: Recent motherboard made for the latest CPU's. Std ATX form factor. Has 3 x (16-bit) ISA slot, 4 x (32-bit) PCI slots, 1 x AGP slot & 3 x DIMM (memory) slots, On-board 1 x PS/2 keyboard, 1 x PS/2 mouse socket, 2 x USB, 1 x parallel, 2 x serial ports. With setup manual & CD. IDE & FDD cables. Brand new in original box. Accepts Intel Pentium II & Intel Celeron CPU's (NOT SUPPLIED) from 233 to 800MHz. The CPU socket is SLOT-1. S-370 CPU could be use with a converter board (NOT SUPPLIED). Selectable 66 & 100MHz BUS speeds & a clock multiplier up to 8 times. Should accept Pentium III CPU's, on a 100MHz bus: (SP6XS) $90

2O x 2 LCD BACKLIT CHARACTER DISPLAY:

Made by Optrex model #DMC2059 (this model is not listed on the Optrex web site, but data is available for similar 20 x 2 displays). Each character measures approximately 6mm x 8mm, display area 122mm w x 30mm h. PCB dimensions 151mm wide x 56mm high. Uses standard Hitachi chipset (HD44780) mounted on a PCB with LED backlight & dual row 16 pin header: (DL8) $11 ea or 3 for $27

12 BUTTON KEYPAD:

Matrix style with a 7 pin connector. The buttons are metal and this whole keypad appears to be very rugged. Looks very similar to keypads used in public telephones. Overall dimensions are 70mm wide by 79mm high. Each button measures 10mm square. This keypad would be very suitable for security applications due to it's rugged construction: (GKP1) $3.50 ea or 3 for $9

12V AUTOMOTIVE RELAY:

Has 30A SPDT Contacts with 730hm relay coil. These are the standard size and normally, retail for around $7 each: (RL3) $3 each

(NEW) INKJET PRINTER COMBIPACK:

Pelikan brand A4 size pack for Canon Colour Inkjet printers (you could probably use it with any brand inkjet). Includes 25 sheets of inkjet paper type UP740, 5 sheets of inkjet glossy paper type IJP710 for professional colour prints and 5 sheets of inkjet 'type OHP-CGF620 OHP film (Clear): (ZA0207) $9 per pack

VIDEO CAMERAS

The output of these cameras below is std video & can be plugged into the "VIDEO IN" socket of any Australian std VCR, video monitor or TV, or via an RF Modulator to an Ant. Input. The B/W cameras are Infra Red responsive & can be used in total darkness with IR illumination.

MONOCHROME CCD VIDEO CAMERA:

B&W Camera built on a PCB with auto iris (0.1 lux). Can be focused sharply down to 10cm (useful for people with visual impairment). Spec.: Power req.: 10V to 12V @ approx. 50mA.CCD: 1/3", 30grams: with 60° $89, with 92° lens:

SUGAR CUBE CMOS B/W CAMERA:

(Reviewed EA Sept. 1999) This (16 x 16 x 15mm) Black & white video camera includes a pinhole lens with a field of view of 56 x 42 degrees. Resolution is 240 TV lines (288 x 352 pixels), 1/3" CMOS image sensor, 2:1 interlace with a shutter speed of 1/60 to 1/60,000. Other features include auto exposure control, backlight compensation, auto gain control. Has an AGC disable pin which can be tied low for outdoor use. It operates from 5V DC and only draws 10mA: (CAM2) $70

COLOUR CMOS CAMERA :

By around the middle of this month we should have in stock a very small colour CMOS camera not much bigger than the sugar cube camera above. CMOS camera picture quality has improved greatly. It should sell for around $120

STEREO FM TRANSMITTER KIT:

This kit accepts a stereo line input from any source and will transmit it on the FM Radio band between 88-108MHz. This kit is based around the BA1044 FM modulator IC. The transmitter in this IC is not very stable in terms of frequency so our kit uses our FM Transmitter MKII for the transmitter section. It operates from 6-12V DC and draws 8mA @ 9V. 25 x 65mm PCB size. PCB plus all on-board components, plus battery connector and 2 electret microphones: (K094) $25

8 CHANNEL PC CONTROLLED RELAY INTERFACE KIT: Ref: Silicon Chip Sept 2000. Operates eight relays from a PC parallel port. Kit inc. PCB & all on-board parts inc. eight relays (2 higher current) with indicating LED's & DB25 connector. Also some simple software on disk, written in Basic, to operate the kit: (K164) $40 A suitable DB25 male to DB25 female data cable is also available for this kit: (K164C)$8

CCD CAMERA INTERFACE KIT

Ref: Electronics Australia October 2000. This kit is designed to interface between CCD Cameras and a Television. Features include regulated 11V to power the camera, an audio amp with an LM386 IC & a VHF video modulator for use with TV antenna inputs. Input to the kit is 14 - 17V AC or DC. The PCB also has provision for a UHF A/V Modulator Kit inc. PCB & all on-board components inc. VHF Modulator, electret mic, speaker & a plastic case: (K163) $18 Kit with CAM1,92 CCD Camera: (K163C) $95 Suitable Plugpack: (PP13) $9 UHF A/V Modulator: (RM1) $18

NEW 30M 10A EXTENSION LEAD
HEAVY DUTY TRADES QUALITY

$30

VIDEO SYNC. STABILISER

During this month we should have them in stock. these devices are used to strip and reinsert the sync. pulse and thus cleaning up videos. It has been suggested to us that these units could be used to copy commercial videos and DVDs but we do not condone any breach of copyright. Dependant on exchange rates they should sell for less than $20 Ring or E-mail us for further details

DC MOTOR WITH FEEDBACK:

12 to 24V starts at 3V. Coil resistance is 130hms. Body measures 58mm long, 40mm diameter, shaft diameter 4mm, pulley on shaft diameter 9mm. The feedback section uses a hall effect sensor with a magnet on the end of the motor shaft. An output via BA14741F op-amp and an open collector transistor gives a pulse for each revolution so the speed could be accurately maintained. The motor can be used independent of the feedback section: (M44)$7 each of 3 for $17

(USED) SAMSUNG TELEPHONE: Why pay a few dollars from your telephone? These used (Ex-Olympics) Samsung telephones will appear in "as new" condition after a couple of minutes cleaning. They feature Recall, Redial-Pause and On Hook keys. A light flashes when the telephone rings and it can be wall mounted by 2 screws (Screws are not provided), the plastic part that secures the handset will have to be reversed so to hold the handset in the vertical position. Has an adjustable 3 position switch for the Speaker volume and an adjustable 3 position switch for the Ringer volume.
A line lead is NOT provided: (ZA0201) $14 each or 3 for $33

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If you have a multiple-computer installation, chances are you have one keyboard for every PC, one mouse for every PC and, of course, one monitor for every PC. And the one thing you don't have is any space left to do all the things you have those PCs for in the first place! KVM (keyboard, video, monitor) Switches from Microgram could be the answer to your prayers. Not only will they save you a lot of space, AND a lot of headaches (like which monitor/keyboard/mouse belongs to which PC!) they can save you a lot of money. With a KVM switch you only need ONE keyboard, ONE video monitor and ONE mouse. A KVM switch will save you money from your second PC. And there are KVM switches to suit up to 16 PCs!

2-WAY PC Controller
Same functions as 4-way controller but handles 2 PCS: If you don't need the power of a 4-way switch why pay for it!!
Cat No 11654 - $199.00

8-WAY Multi-PC Controller: Cat 11656 $949.00 **16-WAY Multi-PC Controller:** Cat 11656 $1299.00

FireWire Interface Card & Editing Software

FireWire to PCI Host Adapter
Connect your digital video camera to your PC. Our Firewire card allows IEEE 1394 FireWire devices (most digital camcorders available today) to connect to your PC at speeds up to 400Mbps. The card has three external and one internal 1394 connection ports to allow connections to hard drives, scanners, VCRs, HDTV, printers etc. Editing your videos is simplified with the bundled Ulead Video Studio DV SE software.

TOP: FireWire to PCI Host Adaptor
- Cat No. 2621 $196.00

BOTTOM: FireWire and USB Combo Card
- Cat No. 2823 $329.00

FireWire External IDE Case

External Case For 3.5in IDE via FireWire

Cat No. 6633
$369.00

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